

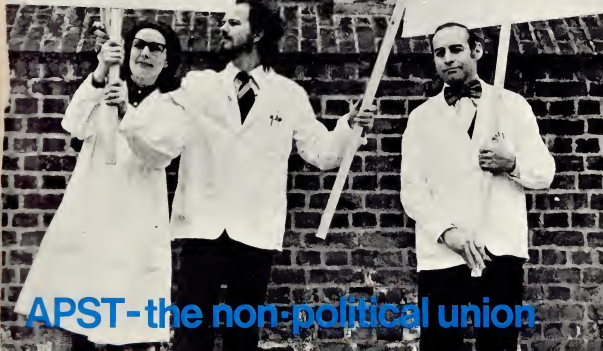
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This One



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Comment

Nuclear power and the electric butterfly

Britain's Members of Parliament probably will do no better than previous seekers of the "right" answer, today, when they debate the issue of the choice of reactors for Britain's electricity generating industry. If civil servant Peter Vinter's analysis of the issues involved could not come up with cast iron conclusions, and if the more recent Nuclear Power Advisory Board is divided on the same issue, perhaps we should acknowledge that it is the nature of the question rather than the quality of the questioners that is behind this inability to find an "answer".

The sad truth is that, whatever the final decision, British industry cannot guarantee that it can build any design of reactor painlessly and punctually. This has little to do with industrial competence. Given a single power station constructor and a steady flow of orders, we might now be high up on the learning curve. So far, we have ordered one reactor design twice (the AGRs at Hartlepool and Heysham are unique in their similarity). Whatever system Eric Varley chooses, we start off at the beginning of the learning curve yet again.

The CEBG supports the US designed light water reactor because it suddenly wishes to go mad with orders—once again reflecting its butterfly nature, flitting from policy to policy. After ordering nothing for six years, and telling the Select Committee 18 months ago that it was not really in the market for nuclear stations, it now wants to order nine new stations (18 reactors) over the next six years.

Britain's nuclear industry, which is now in the hands of the National Nuclear Corporation, needs work, but can it cope with so much? No sane businessman turns away orders, so it is hardly surprising that Sir Arnold Weinstock (head of GEC, the company with a 50 per cent share in the NNC) has done nothing to pour cold water on the CEBG's plans. But Sir John Hill, chairman of the UK Atomic Energy Authority, was cautious about this massive ordering programme when he appeared before the House of Commons Select Committee on Science and Technology.

The only decision that must be taken immediately is on the high temperature reactor (HTR). This is universally accepted as the next step along the chain of nuclear reactor development. An HTR could have been ordered some time ago (plans for an HTR were being circulated some three years ago).

Given that oil and coal are available as a last ditch backstop, if our chosen nuclear programme comes unstuck (such a policy bailed out the US electricity utilities when they were hit by nuclear delays), we can afford to choose a programme that might not necessarily be the cheapest and fastest to come to fruition. We have previously warned in these pages that it is madness to talk of a power station programme based on oil; but the desirability of burning oil must be balanced against the desirability of embarking upon a massive nuclear programme that might all too easily come unstuck.

If we accept the CEBG's chosen ordering programme, there would be a two-year gap before we know that the AGRs have been a miserable failure or could be rescued. Further orders of the advanced gas cooled reactor might be feasible (a possibility that Sir Arnold Weinstock seemed willing enough to accept until the CEBG suddenly presented him with the nuclear option of the LWR). In the meantime it should be possible to build an LWR or two

without tying the country to this system for the next 10 years or more, which seems to be the CEBG's preference, and the NNC's idea of heaven.

New Scientist has previously reported the doubts about the safety of LWRs as reasons for questioning the wisdom of adopting this particular technology in Britain. Evidence, some of it British, is coming forward to suggest that LWRs may not be the delicate time-bombs claimed by America's anti-nuclear brigade. There are still gaps in our knowledge as to what might happen to an LWR pressure vessel under anomalous conditions; but there are also less publicised gaps in our understanding of the safety of British reactors.

We have been warned against diluting our nuclear effort by building more reactor systems than are absolutely essential. Developing HTRs and breeder reactors is said to be enough of a task without adding new AGRs to the burden. Our past nuclear failures were the result not of dilution of effort but of a muddled industry and a chaotic ordering programme.

A future programme for reactor ordering in Britain might be as follows. In 1974 we would order an HTR. At the same time we could shut down the Steam Generating Heavy Water Reactor and transfer its staff to the mainstream nuclear programme (a policy once suggested by the Select Committee). If the CEBG really wants to press ahead with new nuclear orders at its madcap rate, then the government could allow the board to commit itself to the first LWR, on the understanding that if all goes well, and the first LWR successfully negotiates the country's licensing procedure, then a second order could follow in 1975. In 1976 we could embark upon a further study of the situation. This need not be yet another fruitless and bitter inquest. We would then have some experience from both the AGR, and the Prototype Fast Reactor. While 1976 may be too early to proceed with the first commercial fast reactor, it should be soon enough for us to draw some conclusions about the shape of our nuclear future, which will be determined partly by the characteristics of the fast reactors we will eventually build. PFR experience will tell us how important the intermediate thermal reactors (the LWR or AGR) will be, and for how long we might have to build them. During the same year we should have some clues about the progress of the HTR programme. Sir John Hill has maintained that it would not be necessary to complete the first commercial HTR before getting to work on the second: 1976 could be just early enough to evaluate this possibility.

During the next two years the Secretary of State for Energy could also do something to open up the debate so that we do not arrive at the same situation as we have now, whereby influence is won by leak and counter-leak. Eric Varley has said that he wanted to publish the evidence of the NPAB, but the previous government set the whole thing up in such a way that this is impossible. If Mr Varley is still with us after the next election, he can do something about freeing non-commercial information from the clutches of his civil servants and advisors. Members of Parliament, and the informed public, might then find it easier to discover what is going on; and a better understanding can only help in implementing a universally agreed policy. As it is, there is so much bitterness between the various factions in the debate, that it is hard to see how they will work together when the arguing has stopped.

Michael Kenward

Secret 'lie detector' comes to UK

A new form of lie detector that works by voice analysis and which can be used without a subject's knowledge has been introduced in Britain. The unit is already widely employed by the police and private industry in the US, and some of its applications there raise serious worries about its potential here. The Dektor psychological stress analyser (PSE) is used by private industry for pre-employment screening, investigating thefts, and even periodic staff checks. Although at least 600 of the devices are used in the US, there are apparently only three in Britain. Burns International Security Services showed its PSE at the International Fire and Security Exhibition in London last week. Philip Hicks, assistant manager of Burns' Electron Division and the Burns official trained to use the PSE, said that one of the other two units was being employed by a private firm for pre-employment checks.

In addition to the normally understood voice generation mechanisms—vibration of the vocal chords and resonance of cavities inside the head—there is a third component caused by vibration of the muscles inside the mouth and throat. Normally, but not under stress, these voluntary muscles vibrate at 8-12 Hz, and this adds a clearly noticeable frequency-modulated component to the voice. The PSE works by analysing this infrasonic FM component. Dektor claims that the muscle tightening occurs very quickly, and can change from one word to the next, so that it is possible to pick out a word or phrase that caused stress.

Dektor emphasises that the device shows only stress, not dishonesty. Three steps are suggested to overcome this difficulty. First, the subject is supposed to see a full list of the questions in advance. Second, there are "neutral" questions and one to which the subject is specifically asked to lie. Third, if an individual shows stress on a vital question (such as Have you stolen more than £100 in the last six months?), then additional questions must be asked to ensure that this does not reflect an earlier theft or the subject's knowledge of someone else responsible.

The standard report recommended by Dektor is simply the statement "After careful analysis, it is the opinion of this Examiner that the Subject's chart did contain specific reaction, indicative of deception, to the relevant

questions listed below." And Hicks admitted that if a person showed stress and Hicks was unable to ascertain just what caused the stress, he would assume that the stress was "indicative of deception".

In the US, the device is used for pre-employment interviews, with questions such as "Have you used marijuana?", and for monthly checks with branch managers, asking questions like "Do you suspect any present employees of cheating the company?"—which at least prevents a manager from setting his own pace to investigate possibly suspicious behaviour. Finally, US insurance investigators are now using the PSE. They need not carry it with them—only tape record the interview, usually with the permission of the unsuspecting claimant. Not only does an assessor go through the claim form to look for false claims (a questionable practice, because a person is just as likely to stress over being reminded of a lost or damaged object as to lying), but he also offers less money than requested. The claimant's response can, apparently, be analysed to show if he is, in fact, likely to eventually accept.

The potential application of the PSE in Britain is extremely disquieting, especially as there seems no law to prevent its use. The most serious problem is that its primary application will be in situations where people may not object—such as pre-employment interviews. But it can also be used to probe a whole range of personal issues totally unrelated to a job—union and political affiliations, for example. And, of course, the PSE can be used without the subject even knowing; its inventors analysed the televised Watergate hearings and told the press who they thought was lying. Finally, the device is not foolproof, but depends on the skill of the investigator, who receives only a one-week course from Dektor.

In the US, where lie detectors of all sorts are much more widely used, Senator Sam J. Ervin has introduced a bill to virtually prohibit their use by private companies. There may be a privacy bill from the UK government this summer, and hopefully it will include the use of lie detectors. In the interim, trade unions and consumer groups should prevent their use before they become widespread.

Joseph Hanlon

Farming and conservation

Too often, the interests of farmers and conservationists seem to be opposed. This applies especially in those districts where agriculture is economically marginal such as the hill-farming areas of Britain. According to a recent issue of the "News Letter" of the Sussex Trust for Nature Conservation (1974, No 46), for example, good farming practice on the Downs involves ploughing up the old pasture and re-seeding with new grass leys. Even the old turf on the steep escarpments andcombe sides can be brought to greater productivity by aerial dressings of nitrates and herbicides.

From the naturalist's point of view, this is generally detrimental. Traditional sheep-grazing, unlike even the munching of cattle, cropped the grass to a lawn-like texture, which stimulated the growth not only of the grasses but also of the many wild herbs—rock rose, harebell, scabious, wild thyme, rampion—that characterise the Sussex Downs, and which smell, as Kipling said, "like dawn in Paradise". In their turn, the multitudes of insects, especially butterflies like the chalk hill and Adonis blue, depend on these sheep-grazed plants.

For some years, British wildlife conservationists have talked vaguely about the need to subsidise hill-farmers and others to continue the management regimes which produce these distinct habitats, and the recent Sandford Report on National Parks (New Scientists, vol 62, p 155) at last provides a suitable mechanism. Among the report's less well-publicised suggestions is one that a farmer might be financially compensated by a national park authority "in recognition of any constraint that he had accepted... an agreement might provide, for example, that a piece of heather moorland would not be ploughed... If the government accepts this recommendation, it would allow, in national parks at least, the public purse to subsidise certain forms of land management which are economically unviable, but which are desirable from the natural history or scenic viewpoints. The landscape of many of our upland national parks evolved as a result of a happy coincidence of ecological and environmental factors. If the community wishes the scenery to remain the same, it will have to will the eco-economic constraints.

Jon Tinker

Monitor

Cancer in cold store to treat the disease

Two researchers at the Clinical Research Centre in Harrow have developed a new and more efficient method for manipulating cells to be used in cancer therapy. By exposing cancer cells to a chemical known as glutaraldehyde, Colin Sanderson and Philip Frost find that they can induce an anti-cancer immune response greater than has been possible with existing techniques. Although the CRC scientists are cautious about the potential of the technique, Frost told *Monitor* that it could be used to immunise humans against their own tumours.

Unfulfilled claims for the efficacy of immunotherapy against cancer echo around immunological laboratories reminding the current occupants of the enthusiastic myopia of their predecessors. One thing is certain, cancer isn't going to be cured by immunotherapy alone. But controlled manipulation of the immune system is certain to combine with existing techniques to create highly effective combined cancer therapy. The immediate problem is to learn how best to manipulate the immune response. Sanderson and Frost's report (*Nature*, vol 248) takes us one modest but important step nearer that end.

The trick in immunising people against bacteria is to inject into them organisms which are sufficiently intact to induce a specific immune response against them, but not virile enough to generate a full blown infection. The problem is the same with immunising against cancer. Current methods for crippling cancer cells to be used in immunotherapy involve either treating the cells with a chemical such as lodocetamide, or heavily irradiating them (irradiated cells are sometimes employed in leukaemia immunotherapy). Following a clue from another piece of work, Sanderson and Frost decided to try glutaraldehyde because there is evidence that such treatment might ginger up that part of the immune response which appears to be best suited

to attacking cancer (the so-called T cells) while avoiding another part which seems to block anti-cancer activity (the B cells).

So far the CRC scientists have tried the glutaraldehyde technique on three types of cancer (one spontaneous and two chemically induced), all in inbred mice. The results look good. If the inactivated cancer cells are given to the animals about two weeks before challenge with a normally lethal dose of cancer cells, they are protected completely. But the bigger the gap between immunisation and challenge, the smaller the protection—in other words, the immune response wears off. In comparative experiments Frost and Sanderson find that the immune response induced by glutaraldehyde-treated cells is significantly greater than that provoked by cancer cells prepared by conventional methods.

There are many comparisons between anti-bacterial immunisation and anti-cancer immunisation, but the major, and most disappointing difference is that it is not possible to produce a prophylactic anti-cancer immune response. This is because, in humans at least, individual tumours appear to have individual chemical identity markers (antigens). And it is these antigens that the immune system recognises; unless there are markers common to all cancers, or at least common to each tumour type, it is not possible to set up specific prophylactic immune responses because you never know in advance what the challenge is going to be. At the moment researchers are trying to find some glimmer of common identity between human tumours which can be manipulated to induce an immune response.

Meanwhile there is every reason to be optimistic that, although prophylaxis is not yet on the cards, potent immunotherapy will be developed. And one property of Sanderson and Frost's glutaraldehyde-treated cells that make them particularly suitable for immunotherapy is their stability. In their in-

activated state, glutaraldehyde-treated cells can be stored for many months at cold temperatures. This could be exploited in the surgical treatment of, say, breast cancer. When the breast is removed the patient is usually put on some kind of chemotherapy to prevent the tumour returning. But chemotherapy cannot continue indefinitely. So, if some of the removed tumour is given the Sanderson/Frost treatment, and are then stored during the period of chemotherapy, the inactive cells can later be used to immunise the patient to induce a more long-term protection. In other words, the patient is immunised with her own cancer cells.

One more step towards the organic superconductor

The organic salts based on TCNQ (tetracyanoquinodimethane) have a special place in physics at the moment: they are the only organic molecules showing promise of superconductivity.

The behaviour of TCNQ is tantalising. Conductivity rises sharply by a factor of 500 as the temperature is lowered to around 60K but then falls again. This is interpreted as being the onset of superconductivity—characterised by fluctuations into the superconducting state which are destroyed by a phase transition as the temperature is reduced. The phase transition—known as a Peierls transition—is a structural change in the crystal involving a doubling in size of the unit cell. Although the fluctuations and phase transitions are almost certainly linked, the exact mechanisms are still in dispute.

A recent letter in *Physical Review Letters* (vol 32, p 769) throws some light on the problems since it gives the first direct evidence of a phase transition. The experiments, by a team at the University of Illinois, measured the specific heat of TTF-TCNQ (tetrathiafulvalene-TCNQ), the compound that has produced the most startling conductivity peak. The specific heat of this salt shows an anomaly at the same temperature as its conductivity maximum. Anomalies in specific heat are generally associated with a phase transition and further analysis has shown that the results are consistent with the occurrence of a Peierls transition.

If the anomalous conductivity in TCNQ is due to the onset of superconductivity then, before a stable superconducting state can appear, a way must be found to change its structure. The conduction in TCNQ is along uniformly spaced chains of molecules and these collapse into chains of pairs in the Peierls transition. It may be possible to curb the Peierls transition by attaching inert groups to the molecules to prevent them coming close enough to dimerise—but that would not be easy to achieve.

What is left out in left handedness?

Unlike humans, animals do not have right or left hand dominance, apart from certain right handed gorillas and left footed peacocks. So what makes humans predominantly right handed? A psychologist at Hull University has been examining families in which both parents are left handed in order to explore the theory of a human "dextrality factor".

Marian Annett believes that in man the primitive—animal—pattern of equal left and right handedness is overlaid by some essentially human factor (the dextrality factor) that favours right handedness. The idea is that, in the

absence, or at least a low level, of the factor a person is equally likely to be one or the other; but left handed always have small amounts of the factor.

In her latest project Annett tested the handedness of the offspring from "doubly" left handed parents. Her theory predicts that, if both parents passed low doses of the factor to their children, the offspring would be just like animals; in other words, they would be just as likely to be left or right handed. This is exactly what Annett found (*British Journal of Psychology*, vol 65, p 129).

Annett's results give support to the growing belief of the notion that handedness is genetically determined.

A rare ragwort reappears in the fens

The rediscovery in a Cambridgeshire ditch of the supposedly extinct ragwort *Senecio paludosus*, recently reported in *Watsonia* (vol 10, p 49), poses some interesting questions about the survival of this rare plant. According to Dr Max Walters, director of the Cambridge botanic garden, five stems of the tall (90 to 140 cm) weed, which superficially resembles the abundant fenland flower corn sow-thistle, turned up on 18 July 1972 on a Cambridgeshire farm. The last certain British record was at Wicken Fen in August 1857, although Dr Walters suggests that the species might have survived elsewhere in Britain until now.

The Cambridgeshire and Isle of Ely Naturalists' Trust promptly negotiated an agreement with both landowner and local authority to protect the site from accidental damage, and the management of the length of ditch where the plant was found is being left to the trust. This management will not be easy, as the reed-swamp habitat in which *S. paludosus* grows is impermanent. It is in a ditch, and dependent on regular cutting and clearing. Although less than 1 per cent

of the flowers set seed, some of these were collected and sown in the university botanic gardens, where 21 seedlings grew. The plant is thus assured in cultivation; the site is to be kept secret to protect it from trampling or collection by eager botanists.

The origin of the Cambridgeshire colony, reappearing within the plant's former range after an absence of perhaps a century or more, raises some intriguing possibilities. Dr Walters suggests three hypotheses: that it never in fact became extinct in Britain; that it has naturally recolonised the ditch from its European range, perhaps as a seed carried on a bird's foot; or that it has been deliberately reintroduced. The ditch in question was not dug until 1968, so *Senecio paludosus* cannot have long been growing at exactly its present site and, although no nearby colonies were found in 1972, a thorough search of nearby fen ditches has yet to be made. Although it seems unlikely that such an unmistakable species should have been overlooked for so long, Dr Walters comments tartly that botanists, like other

folk, see what they expect to see.

Deliberate reintroduction is unlikely on two grounds. First, no botanist would be so "misguided" as to perpetrate such a hoax; second (and perhaps more potentially), Dr Walters points to practical difficulties experienced by conservationists in effecting similar reintroductions on nature reserves. Although avian transport is quite possible, it seems most likely that the digging of the ditch stimulated germination of seed which had lain dormant in the fenland peat for a century or two. Dr Walters points to a similar phenomenon with another fenland rarity, *Viola stagnina*, which reappeared after scrub clearance at Wood Walton nature reserve. The apparent sterility of the 1972 flowers suggests that the present specimens are partially self-incompatible, perhaps arising from a single seed or even a single cone.

When the lunar bombardment reached its climax

New results from the isotopic dating of lunar samples strongly imply that the Moon underwent a gigantic cataclysm of bombardment from the residual fragments of the newly formed solar system in a narrow time interval close to 3900 million years ago. During this time the maria Imbrium, Crisium, and Orientale seem to have originated.

Writing in *Earth and Planetary Science Letters* (vol 22, p 2), Fouad Tera, D. A. Papanastassiou and G. J. Wasserburg of the Lunar and Planetary Institute of the Charles Ames Laboratory at CalTech, have assembled a number of powerful lines of argument in support of this claim. Lunar highland samples analysed by uranium-thorium-lead, rubidium-strontium, and potassium-argon techniques all point to one conclusion: the lunar surface underwent extensive recrystallisation and redistribution of its elements as a result of large-scale impacts in a time interval shorter than 200 million years, at a date some 3900 million years ago. The intensity of bombardment fell sharply after this period.

At around the same time, the three workers say, the lead in lunar surface rocks was extensively mobilised, presumably as a result of the heat generated by this climax of lunar bombardment. Uranium-lead ratios were severely altered by the volatilisation of lead, and lunar soils enriched in that element.

Uranium-lead isotope data have indicated that lunar crust began to be formed later than 4600 million years ago and the process continued until some time around 4400 million years ago. This age is comparable to that normally assumed for the formation of the Earth's crust—4500 million years. The Lunar and Planetary Institute team believe that the Earth may, like the Moon, have suffered a similar cataclysm of bombardment (whose traces have since been largely eroded away) around 3900 million years ago. The ages of meteorites derived from isotopic dating methods indicate that they were formed much earlier than either the Earth or Moon.

But where do the speckles come from?

If brown eggs are the subject of any discussion at all, it is usually on the question why they are popular, rather than why they are brown. But Torben With of Svenborg Hospital in Denmark is interested in this latter question, and has come up with a result to confound the egg-sports (*Biochemical Journal*, vol 137, p 597).

According to the literature the brown colour is due to the presence of a porphyrin, protoporphyrin, which is also an important component of haemoglobin and the cytochromes. But With has shown by careful extraction and separation of the pigments by thin-layer chromatography, that this is mixed with significant amounts of several other porphyrins, including coproporphyrin and uroporphyrin. The significance of the result is that these other porphyrins are on the route of biosynthesis of protoporphyrin rather than breakdown products. Rather than being the result of haemoglobin degradation, the brown pigments of egg-shells are actually synthesised in the oviduct where the egg is formed.



X-ray telescopes reveal a powerful new source

The Uhuru satellite has discovered a class of extragalactic X-ray sources identified with clusters of galaxies. The data are not sufficiently detailed to reveal the source mechanism. However, they do show that the emission extends over the visible core of the cluster. The brightest of these clusters lies in the constellation of Perseus and contains a well known radio source, Per A, which coincides with a large active galaxy NGC 1275. This galaxy is characterised by filaments of matter streaming out at 3000 km/s, and it is interesting to note that it has now been discovered to be a very powerful X-ray source in its own right.

The Perseus cluster was studied with the University College London (UCL) grazing incidence X-ray telescopes on the Copernicus satellite. Analysis of the data by a joint team from the Mullard Space Science Laboratory (UCL) and the

University of Leicester, revealed X-ray emission from the cluster itself, as well as from NGC 1275. At 10^4 ergs, NGC 1275 is at least five times more luminous in X-rays than the whole core of the Virgo cluster.

The only object of galaxy size or less that exceeds NGC 1275 in X-ray power is the quasar 3C 273. Our own Galaxy pales into insignificance, being a factor of 10^4 weaker.

It is most unlikely that binary X-ray sources such as occur in our Galaxy are responsible for the emission in NGC 1275. Far more probable is some interaction occurring in its galactic nucleus. Further study to test various hypotheses about the emission mechanism will probably have to wait a few years for the next generation of X-ray telescopes. Other astronomers working at longer wavelengths have previously suggested that NGC 1275 is a nearby mini-quasar, and it does not seem to lack similar X-ray power.

Can alcoholics have a tippie or two?

The standard prescription for alcoholism is total abstinence. Is this effective and are there any alternatives? These questions were raised at the British Psychological Society's Annual Meeting held recently in Bangor. Clinicians experienced in treating alcoholism view it as a disease and as a disease which cannot be cured: without total abstinence patients will relapse into pathological alcoholic excess. Yet, treatments based on this attitude are counted as successful if as few as 10 to 15 per cent of the patients are sober two years after the start of treatment! Furthermore, the problem is getting worse. It is no longer just middle-aged men who require treatment. The number and proportion of younger men and women who are registered as alcoholics increases every year.

The disease concept is useful in that it allows people to ask for help, and comforts relations hut, as psychologist James Dremery of Dumfries suggested, the goal of abstinence is a major deterrent. Alcoholics are dependent on alcohol, and before they can face the thought of giving it up completely they have often lost wife, family, job, money, friends, health, and self-respect—all things which are needed for the process of rehabilitation and redirection. The belief that retreating to moderation rather than complete abstinence is possible might persuade some people to ask for help before the rest of their lives became catastrophic.

Is social drinking a realistic goal for alcoholics? In clinical experience a successful return to social drinking in alcoholics is rare, and for some clinicians a contradiction in terms (anyone who can moderate their drinking is by definition not an alcoholic). It is perhaps not

surprising that so many treated alcoholics relapse completely; after all, the treatment is designed to eliminate all drinking, and to achieve controlled drinking the patient must be taught to recognise both physiological and behavioural responses to alcohol.

Gloria Litman, of the Institute of Psychiatry in London, emphasised this point when she showed that there were good theoretical reasons for the relative lack of success of the most extreme aversive treatments. Patients still experimented with alcohol even though the drug-induced reactions were severely traumatic. The trouble with such treatments is that they provide no alternative response to that of drinking. Spitting out the drink scarcely seems a satisfactory alternative and, for Litman, drinking orange squash is about as aversive as the treatment itself! Controlled drinking would, in theory, fill the requirement.

Early attempts to teach controlled drinking have been successful, but only within the confines of an institution. The problem is basically to switch control from the environment to the self; to achieve this end, attitudinal and motivational modification is necessary as well as behaviour modification.

Douglas Cameron, of the Crichton Royal Hospital, Dumfries, described his study on the physiological and behavioural responses to alcohol of both normals and alcoholics. Before we can teach alcoholics to restrict their drinking to social drinking we must understand what social drinking is, he said. When the Dumfries team gave alcohol to normals they found that in spite of the conventional pharmacological view that alcohol is a continual depressant, virtually every-



one reports an initial stimulant effect. In a learning model for social drinking it is those feelings associated with automatic arousal which serve as reinforcement for drinking behaviour.

Do alcoholics drink for the same reason? Not according to Cameron. Alcoholics become anxious and uncomfortable soon after starting to drink. The excitation/intoxication phase which is the aim for normal social drinkers is unpleasant for the alcoholic and hard drinking is needed to push through to the depressant stage. Unfortunately he tends to overshoot wildly. As Cameron sees it, the task for the future will be to teach the alcoholic how to predict the end of the stimulation phase and stop as soon as the desired goal had been reached.

Encouragement for the general plan comes from the latest work by the Addiction Research Unit at the Institute of Psychiatry in London. Jim Orford, reporting some of this work, said that normal social drinking is in the repertoire of a number of alcoholics, particularly those with less high expectations of the treatment. This work suggests the possibility of being able to predict in advance those alcoholics most likely to achieve social, controlled drinking.

By the end of the symposium a fairly convincing case had been made against the blind application of the total abstinence dictum. New treatments could give a measure of control to a large number of patients. However, all the speakers stressed that it could be disastrous for alcoholics who are currently on a successful abstinence regime to think that they could switch by themselves to social drinking. The techniques are subtle and need to be taught.

Mineralisation on the Mid-Atlantic Ridge

A new aspect of mineralogy and plate tectonics is the recent discovery of a rich metallic province, some 40 square miles in extent, in the median valley of the Mid-Atlantic Ridge (see map). The result of dredging operations by the US National Oceanic and Atmospheric Administration during their so-called Trans-Atlantic Geotraverse, the

region represents an area of extra-high hydrothermal activity. Manganese deposits sampled there are pure and indicate accumulation "one hundred times faster than other manganese deposits" from elsewhere on the sea floor. The hydrothermal field appears to have similarities to the mineralogically rich "hot spots" discovered on the floor of the Red Sea—now assumed by many geophysicists to be an ocean in the process of formation.



A metal shield against colds

If the daily tablet of vitamin C doesn't fight off the colds, a touch of zinc solution up the nose might help complete the trick. Du Pont scientists in Delaware, US, have discovered that dilute solutions of zinc chloride (0.1 mM) inhibit the multiplication of many rhinoviruses, the group of viruses responsible for many a snuffy human nose. It seems that the metal ion interferes with the cleavage of precursor protein molecules after they have been synthesised, the one most affected being important for capsid (virus coat) formation.

Of more than 10 common metal ions tested, zinc was the only one to display any marked anti-virus activity without at the same time being toxic to human cells (Nature, vol 248, p 588).

Secrets of antibody diversity come from baby mice

Where their immune defences are concerned, baby mice, in common with many other mammals, do not spring fully armed from their mothers' wombs. The gradual development of their immune "competence" has been the subject of study by Pat Spear, working in Gerry Edelman's laboratory at the Rockefeller University in collaboration with Ailan Wang, Urs Rutishauser, Edelman himself—and innumerable mice. From this research Spear and her collaborators have started to collect some basic data on the differentiation of the various cells of the immune system. At the same time, they have found evidence which strongly reinforces one of the two leading classes of theory on how the body's white blood cells can produce, to order, antibodies to match an almost limitless variety of foreign antigens.

One theory, the somatic mutation theory, says that the lymphocyte genes which code for the antigen-recognising site on the antibody are prone to extensive mutation so that a huge library of different antibody producing cells is built up during the animal's life time. The other theory says that the diversity is produced not by random mutation but by recombination of existing lymphocyte genes. The essential difference is that whereas with mutation, antibody diversity would develop *de novo* in each individual, recombination would act on inheritable genes subject to the pressures of selection during evolution of the whole species.

Recently, Monitor bailed the turning of the tide of evidence in favour of the recombination type of theory, with the discovery of broad similarities in the structure of the variable (antigen recognition) sites of antibodies (*New Scientist*, vol 61, p 669). These similarities point to a common evolutionary origin.

Now it turns out that the characteristics of the lymphocytes of mouse foetuses, too, militate against mutation theory. Spear and her colleagues looked at some of the types of antibody expressed on the surface of white blood cells known as B lymphocytes in two-week mouse foetuses. The B lymphocytes are those which in adult mice respond to the appropriate antigen by proliferating and giving rise to cells which actively secrete antibody into the bloodstream. The type of antibody produced is the same as that on the surface of the original precursor B lymphocyte.

The Rockefeller team wanted to find out how the characteristics of the foetal surface antibodies compared with those found in mature mice. It emerged that they had three things in common—all three things on which they were tested, in fact. About the same proportions of cells bound to each of the three experimental antigens, whether you looked at the proportion between the antigens or compared with the total number of B cells; moreover, the enthusiasm with which each antigen was bound varied over much the same range in adult and foetus. Variation in the enthusiasm, or avidity, of surface antibodies on different

B cells for a given antigen is a measure of the number of different antibodies which will bind the same antigen: they do not all bind with the same firmness. So if not all the antigens is equally easy to shake off the cells, it is generally inferred that not all the cells have the same surface antibody.

Spear and Edelman (*Journal of Experimental Medicine*, vol 138, p 557) reason that the similarity in degree of diversity between B cells in the foetus and B cells in the adult is quite inconsistent with a process of mutation and selection during the lifetime of the individual. And there is another embarrassing fact for mutation theory: the three types of antigen specificity all appear within 24 hours of one another in the course of foetal development—which looks more like genetic pre-programming than mutation.

Spear and her co-workers were able to show the simultaneous appearance of three different types of antibody because they were looking at the binding capacities of the B lymphocytes, and not at the actual production of antibody in response to injections of antigen. In fact, mice

cannot actually produce antibody until two weeks after birth. Spear and Edelman have pursued the question of why, if the precursor cells are there, they apparently still cannot proliferate in the presence of a suitably provocative antigen—and they believe they have traced the answer to the so-called T "helper" lymphocytes.

These cells help to trigger the proliferation of antibody-producing B cells in the normal adult immune response. Spear and Edelman found that if they added a stimulating chemical (lipopolysaccharide) to test-tube cultures of lymphocytes of immunologically immature mice in the presence of antigen, the B cells were perfectly well able to produce antibody.

The question remains whether the lipopolysaccharide stimulates the B cells directly, or whether it induces the maturation of T cells which are then able to perform their normal helper function. Either way, the answer should throw some interesting light on the control of growth and differentiation in interacting cells.



Acid droplets may speed up photochemical smog

A bright sunny midsummer day in Los Angeles or Tokyo, as many cars on the streets as usual, and what do you have?—ideal conditions for the formation of photochemical smog. In Britain climatic conditions are unlikely to produce this uncomfortable type of air pollution. Some of us may remember the London smog of 1952 but this type of highly dangerous "smoke-fog" has now been eliminated by the enforcement of smokeless zones. The two sorts of smog have very different constituents. London smog contained a high proportion of sulphur dioxide (SO_2)—a by-product of fossil fuel combustion. In contrast, Los Angeles or Tokyo photochemical smogs supposedly contain hydrocarbons, oxides of nitrogen, carbon monoxide, and ozone. (The highly oxidising ozone is formed photochemically from nitrogen dioxide). Monitor was therefore surprised to find, in a current paper concerned with mechanisms for liquid aerosol formation, the statement "sulphuric acid and water liquid aerosols are known to be major constituents of photochemical smogs".

This conclusion might indicate that theories for photochemical smog formation still entertain some controversy! Although several different mechanisms have been proposed for photochemical smog formation, to date only gas-phase reactions have been considered. Scientists at the Institute for Colloid and Surface

Science, and the Department of Chemical Engineering in Potsdam (NY) writing in the *Journal of Chemical Physics* (vol 60, no 3, p 1138) now challenge the basis for the currently accepted mechanisms.

Philippe Mirabel and Joseph Katz have been studying heterogeneous and homogeneous nucleation mechanisms for cloud formation. The humidity of the atmosphere appears to be one of the most critical weather factors governing photochemical smog formation. Heterogeneous nucleation can produce condensation when the supersaturation is only 1 or 2 per cent, but for homogeneous nucleation a supersaturation of about 300 per cent is needed. Large supersaturations are normally prevented because of particles in the atmosphere from smokes, dusts, soluble particles (NaCl) and, interestingly, liquid aerosols—all of which produce condensation by acting as nucleation centres. The two chemists use thermodynamic and kinetic theories to study how certain liquid aerosols can be formed from water vapour and a reactive pollutant such as sulphuric acid (from H_2O and SO_3), or nitric acid.

After exhaustive calculations Katz and Mirabel show that the sulphuric-acid-plus-water aerosols are very likely to form above heavily populated and industrialised areas. The potential importance of this work is linked to the gas-phase reaction mechanisms mentioned above. If some of the interesting reactions of hydrocarbons, oxidations by ozone, etc., are quicker in liquid acid solution, then the presence of sub-microscopic aerosols with an enormous number of concentrated sulphuric-acid and water droplets would effectively make liquid-phase reactions possible in the atmosphere and the basis for the mechanisms to tally inadequate! This conclusion increases the possibilities for other mechanistic interpretations and should precipitate interesting discussion among gas-phase kineticists.

What means the pattern on an insect's belly?

If you mistakenly drew Wales upside down on a map of the British Isles, it wouldn't obligingly turn itself the right way up again. But if you take a sheet of living cells from the skin of a growing insect and deliberately turn them round before putting them back, they seem to do just that. Which is what makes the insect epidermis and cuticle probably the most graphic system in existence for investigating what controls the patterning of development in growing organisms. The investigation of living moving, multi-coloured developmental maps on a variety of bugs has recently borne threefold fruit in a fleet of reports in *Nature* (vol 248, pp 608, 609 and 610).

Michael Locke started it twentyfive years ago with investigations on the ripple patterns on the cuticle of the bug *Rhodnius* and what happened to the pattern if you turned part of it round. His lead has been followed more recently by Peter Lawrence and his colleagues at Cambridge, where a really hard look at the consequences of setting *Rhodnius* ripples at right angles has resulted in the formulation of two possibilities for how the insect epidermis achieves its gradual readjustment. Do the cells change their nature to conform to their new position, or do they simply walk back to where they belong? Three laboratories have now put the question to three kinds of experimental test, and the answer seems to be yes.

Horst Bohn in Munich abandoned the original bug, *Rhodnius*, because its pattern of transverse ripples doesn't offer clear enough pointers to what is happening to individual cells. Instead, he chose to perform graft rotation experiments on *Leucophaea maderae*, whose larva has two kinds of skin: bristly, at the front, and tubercular, at the back, with a ridge separating the two.

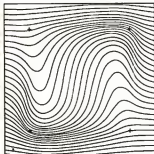
Bohn cut out a piece of skin including bristles and tubercles on either side of a section of ridge and switched them over. He then followed the fate of the rotated segment as the insect moulted, and found that it steadily re-rotated itself as the insect

grew. Bohn satisfied himself that it was the same cells in different positions by noting carefully the exact pattern of bristles and tubercles, which are very variable in this insect, and checking that it did not change during rotation.

The experimental technique chosen by K. Nühler-Jung, at Freiburg, was more complex, more colourful and more direct than Bohn's. He selected an insect (*Dysdercus intermedius*) whose larva has a red front and a white back end, grafted a rotated red and white section of skin onto a grey-and-white mutant of the same species, and took time-lapse movies of the consequences.



Rhodnius cuticle realigning after a 90° turn (actual and map)



Thus he had a graft whose edge was clearly defined and which could be followed continuously through the period of readjustment—for he was filming the living skin cells, and not just examining dead hard cuticle at regular intervals, as in *Rhodnius*.

To redifferentiate according to their new positions, the cells would have to turn over from manufacturing one kind of pigment to the production of a different kind. Instead of performing this feat of genetic re-tooling, however, the films showed that the cells, like those in Bohn's *Leucophaea*, moved back to their proper orientations.

Peter Lawrence is the only one of the three who has found possible

evidence for static readjustment of rotated cells, in one or two sets of experiments on orange and white larvae of yet another species—*Oncopeltus*. *Oncopeltus* is usually orange, but sports a white mutant and by X-irradiation at the egg stage can be induced to come out in white patches here and there. For his first experiment, Lawrence chose irradiated larvae which had finished up with white stripes on their orange skins.

He removed a piece of skin containing the white strip, grafted it, rotated, onto a mutant white larva, and measured the change in the angle of the graft at successive moults. Here his results conformed with those of his German colleagues. But he then went on to perform, at the suggestion of

Horst Bohn, a further set of grafts, this time of orange skin transplanted onto white larvae after rotation through 90°. Although these stripes generally remained orthogonal to the skin of their new host, the individual hairs all turned round so that they were pointing front-to-back as usual, instead of sideways. Somehow, individual portions of the graft had changed their polarity without bodily movement of the whole graft. It could still be done by movement, of course: the cells could twist round on the spot; which brings us back to the original question on a more detailed level: cell movement or re-differentiation?

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Scientists and unions

The demise of the Conservative government's Industrial Relations Act may put new pressures on scientists to act collectively. As a result, the Association of Professional Scientists and Technologists, created in 1971 to protect scientists from enforced involvement in politically-aligned unions may take on increased significance

Dr Maurice Gillibrand

is the Executive Secretary of the Association of Professional Scientists and Technologists. The views expressed in this article are his personal opinions and are not necessarily those of the Association

Scientists are aware that a further stage in the long saga of statutory arrangements for industrial relations in this country is about to be enacted in Parliament. The most recent attempt by the Conservative government to regularise industrial relations under the Industrial Relations Act 1971 clearly failed to achieve its main objective, although many will claim that it proved of great benefit to a large number of employees and resolved many industrial disputes of which the general public was unaware. Undoubtedly the main cause of the failure of this Act was that it did not gain the confidence of a large section of the trade union movement. Indeed the TUC unions actively opposed the Act, although some of its member unions who found opposition to the will of Parliament unacceptable or considered that this was not in the interests of their members, had to leave the TUC. In general non-TUC unions represented groups of employees who would not wish to oppose Parliamentary decisions although experience was to show that the Act rarely worked to their advantage.

The 1971 Industrial Relations Act contained provisions which were of immediate concern to scientists at the time. To a very large extent scientists were not members of unions and perhaps did not wish to become members. Although the Act protected the right of individuals not to join a union it was clear that unions would secure the right to regulate their salaries and conditions of employment if they used the provisions of the Act. Indeed the Act went further than this insofar as the "agency shop" arrangement could require an employee to become a member of a particular union as few would have met the conditions of the exemption clause. Thus it was all too apparent that the stage was set for minority groups of employees such as scientists to find their conditions of employment being negotiated by unions controlled by the larger membership of technicians, supervisors and clerical staff. That this did not happen is the direct result of the non-cooperation of the TUC unions with the Industrial Relations Act. Thus the danger passed and scientists again became preoccupied in their work with little concern for the issue of union membership.

The situation has now changed dramatically and new proposals are before Parliament which will have the support of the TUC unions. The National Industrial Relations Court is to be abolished and the registration of unions is to be replaced by certification by the Registrar of Friendly Societies in a way similar to the arrangements before the 1971 Act. It appears that the function of the National Industrial Relations Court (NIRC) and the Commission on Industrial Relations (CIR) in resolving industrial disputes is to be taken over by a new statutory body to be

known as the Conciliation and Arbitration Service (CAS). At the same time much of the existing Industrial Relations Act relating to unfair dismissals and industrial tribunals is to be retained.

A direct consequence of the participation of TUC unions in the new Act will be that scientists will find themselves once more in the forefront of issues affecting their conditions of employment. Scientists who are not members of unions may find that once a union has secured an agreement with their company they will have no alternative but to join that union. Indeed, the new Act will make it fair to dismiss an employee for refusing to belong to an independent union under such circumstances. Thus the scientists are now back again in the very same situation which caused concern to the Chartered Institutes for Science and Technology in 1971. At that time the Council of the Science and Technological Institutes (CSTI) concluded that the only protection for scientists was to create a professional union which would be non-political and controlled by its professional membership. The Association of Professional Scientists and Technologists (APST) was formed precisely for this purpose.

APST was by no means the first of the professional unions. Unions such as the Institution of Professional Civil Servants (IPCS) and the Association of University Teachers (AUT) were already well established in the public sector, and professional unions were not unknown in industry. For example, the British Association of Colliery Management (BACM) and the Steel Industry Management Association (SIMA) have been recognised by their employers as the appropriate unions for managerial staff for some years.

However, as APST is the most recent of the professional unions, it is an appropriate time to assess its policies, its achievements and future prospects.

Achievements of APST

During the past century the discoveries and innovations of scientists have completely revolutionised industrial life. Particularly they have been responsible for creating a whole new sector of science-based industries, specifically in chemicals, pharmaceuticals, electronics, and nuclear energy. The welfare of these industries depends on scientists and their associated managers playing a leading but independent role in their future. It is thus inappropriate that many scientists should find their status and relative levels of remuneration are now in jeopardy, and indeed should often experience their professional judgements, which are based on a deep understanding of their subject, being over-ruled by some superficial management gimmickry. The majority of scientists still

consider that they can deal with those problems as individuals, but others now realise that the profession is in a state of crisis which can only be resolved by collective decisions. APST is the mechanism by which they can make such collective decisions, as its membership is limited to:

1 members of an appropriate professional institute;

2 those with a degree in science or an allied technology;

3 those who have obtained an appointment at a professional managerial level in a science-based industry (ie, at the same managerial level as 1 and 2) by reason of their experience.

APST's sole purpose is to represent its members in a responsible manner and its activities can be broadly divided into two classifications. One is promoting and protecting the interests of individual members, and the other is collectively representing groups of members. Thus many APST members have sought the assistance of the association on individual professional matters. For instance, reorganisation of company structures seems to be commonplace today, and can adversely affect members' interests. (Too often such reorganisations are only manoeuvres in company politics aimed at giving the semblance of progress, although in reality they result only in disorganisation and the lowering of morale.) In many cases, following the intervention of the association, management decisions have been changed and the position of members fully restored. Again, the assistance of the association has been sought by members faced with redundancy and, invariably, greatly improved severance terms have been obtained. In all cases awards have been improved by the intervention of the association, and in some exceptional situations the support of the association has resulted in compensation of many tens of thousands of pounds. Only on one occasion has the intervention of the association not resulted in an amicable settlement, but the association then engaged counsel to represent its member before a tribunal and obtained a favourable judgment with compensation equivalent to one year's salary.

Collective representation depends on the association being recognised by the employer and this in turn is dependent on a sufficient number of scientists being members of the union. Thus the type of agreement which APST has been able to negotiate with the employer to some extent reflects the level of membership. Where the percentage membership is small the employer naturally has been reluctant to conclude an agreement and the union has done a good job where it has succeeded in negotiating an agreement for individual representation. Such an agreement usually grants the union the right of making representation on behalf of individual members and to be their advocate in the event of a grievance situation.

At the other end of the spectrum, if membership of the Association represents

more than 50 per cent of the common interest group, employers have been more willing to respond to the wishes of scientists, and agreements for sole bargaining rights have been negotiated. Agreements of this type give the union the right to make representations both individually and collectively on a wide range of issues, including an exclusive right to negotiate the salaries for the whole group of staff covered by the agreement. Between these two extremes, other agreements have been concluded which, although not giving exclusive bargaining rights, give considerable rights of collective representation where this has been justified by the level of membership.

Undoubtedly the best interests of the members of the association are served by a sole-bargaining-rights agreement and this will always be the ultimate aim of any union. This goal can be approached in two different ways. In some companies, such as ICI Ltd, membership is growing at a steady rate, but while it was still a small percentage of the total number of scientists employed, the association's task was to obtain recognition for individual representation. Similarly in Laporte Industries Ltd, APST obtained recognition for individual representation, but subsequently secured an agreement for collective representation and bargaining rights as membership increased. In contrast, scientists in some companies, such as Croda Bowman Chemicals Ltd, have met in a group and resolved beforehand that APST was the appropriate organisation to represent their interests and have joined in substantial numbers. This approach has advantages to all concerned—the employer, the union and the staff. The employer is left with no doubt that the staff wish to be represented by a union and the union has a clear mandate to negotiate an agreement for sole bargaining rights. One of the most important aspects of such an agreement is that once an agreement has been signed, the association has been able to press for progressive career salary scales.

Employers collaborate

Experience has shown that the employer is only too willing to collaborate with the union in order to create a systematic remuneration system. An example of such collaboration between the union and the company has resulted in progressive salary scales being instituted at Organon Laboratories Ltd. These provided for a graduate starting with the company at a basic salary of £1870 having guaranteed increments over 15 years. In an alternative scale, a scientist who has produced above average results progresses to a maximum of £4045 over the same period. In addition to these basic scales, section leaders or specialists with additional responsibilities will be guaranteed an initial starting salary of £2860, progressing by 11 annual increments to £5060. At the same time, APST and Organon Laboratories have agreed a confidential scale for scientists holding more senior appointments under which they will be guaranteed a progression over 10 years to a final salary of more than £6000 per annum.

All these scales are based on the cost of living at November 1973 and exclude any subsequent cost of living awards. Immediate increments to members have had to be curtailed by Phase 3 legislation, but the company has assured APST that the scales will be automatically implemented when legislation permits.

A union's prime responsibility is to represent its members. On occasion this will involve conflict. However, members of a professional union require that the union should make every attempt to avoid conflict. For instance, although the interests of members are to a large extent compatible with their employers' there will be occasions when they differ. Such circumstances can be resolved when the union has negotiated a procedural agreement with the employer which provides for arbitration as scientists invariably are willing to abide by the decision of an independent arbiter. In exceptional circumstances a company may not be prepared to negotiate such an agreement and the situation can then only be resolved by members of the union carrying out sanctions. It should be recognised that techniques such as strike action, used by the manual and white-collar unions, would not only be ineffective but would also not be acceptable to the membership. In contrast, the Rules of APST provide that members shall not take up a new appointment with an organisation in dispute with the association and that shareholders, Members of Parliament, customers and other appropriate persons may be petitioned to use their influence in resolving the dispute and ensuring that the company provides acceptable professional conditions for the employment of scientists. Sanctions are normally taken by the association at the request of the members employed by the company and conflict can invariably be avoided once the company is convinced that the members of their staff are determined to see sanctions employed.

Another type of conflict which a new union must be prepared to face is that with other established unions. It is the duty of all unions to avoid such situations. Any union which encourages them is damaging the whole of the union movement. Thus it is incumbent on the newly formed union to avoid recruiting among groups of staff which have already become unionised and in particular should not attempt to recruit the members of another union. About 90 per cent of APST members have never been in a union previously and would not have joined had it not been for the advent of APST. At the same time the association recognises the right of any employee to join the union of his own choice and the right to be represented by that union. In consequence, APST is willing to co-operate with any other union and respect its rights, expecting a reciprocal respect for the rights of APST members. Interunion conflict can further be avoided by agreements with other unions. Thus APST has an agreement with the United Kingdom Association of Professional Engineers (UKAPE) and the Association of Supervisory and Executive Engineers (ASEE) whereby they act jointly where they

have common membership. At the same time, although APST has appreciable members in the civil service it has come to an agreement with the Institution of Professional Civil Servants (IPCS) whereby the two organisations define their respective interests and undertake to co-operate with each other on issues of common interest to their members. Of increasing importance will be the agreements within the European Economic Community. APST is a member of the Federation Internationale des Cadres de la Chimie et des Industries Annexes (FICCIA), which gives APST support from the powerful staff unions in the chemical industry in France, Belgium, Germany and Italy.

Future prospects

The formation of APST coincided with the introduction of the Industrial Relations Act, when it was believed that the scientist's professional right to negotiate his own conditions of employment was in jeopardy. This Act is about to be repealed and undoubtedly the new legislation will affect relationships between scientists and their employers. The instigators of the Industrial Relations Act believed that they were ensuring that justice would prevail in disputes and such new legislation can only hope to be successful if it combines the need for justice within this sphere of human relations with general acceptance. Undoubtedly the provision of new legislation may herald the return of the "closed shop" principle. This would constitute a threat to the unorganised scientist who might be required to join a union as a condition of employment. It is unrealistic to think that the individuals could resist such demands, so the challenge for the scientist is to choose whether to allow events to take their course or alternatively to join a professional union now and thus create a strong and powerful body whose policy will be determined by colleagues of equivalent professional standing.

The new legislation is likely to create an even greater need for unionisation among scientists, but at the same time it is likely that the battles for recognition will become intensified. When APST was first formed, statements were made that it would never survive, but in time, when it was apparent that the organisation was increasing in strength, the cry became that it would not be recognised by employers. Subsequently, when this was also proved to be erroneous, its critics claimed that it would never obtain negotiating rights. It can be anticipated that some will be so foolish as to claim that the new legislation will work to the detriment of the professional unions. Again they will be proved wrong, as APST will promote the interests of its members according to the law, but it will no doubt adapt tactics appropriate to changed circumstances. APST membership is for those who wish to secure the right to negotiate their conditions of employment in a responsible manner. It is for those scientists who wish to control their own organisation and are determined to preserve their professional integrity.

Datafront

Securing computer people

In the name of computer security, work conditions and labour relations for data processing personnel are being radically altered. How will the dp workers respond?

Dr Edward

Harriman
has recently completed a report on databanks for the National Council for Civil Liberties and

Hedley Voysey

The brochures and advice now being offered by the security industry, many computer firms (IBM included), and even the National Computer Centre leave no doubt to the matter. For them it is clear that while preventive measures stem initially from something amorphously called "good labour/management relations", additional protection is now essential. This can include complete fragmentation of work tasks, dehumanisation of work place (the computer room), and constant staff surveillance. The ultimate in physical security is now seen to be a computer room with no windows and only one well guarded entry where complicated identification checks are made. The room is partitioned into small cells in which data processing personnel perform their discrete tasks, passing material such as discs to each other through hatches, communicating only in simple coded messages. It is further recommended that staff do not mix socially, and that work be split between geographically separate locations.

This may insure security, at least from the hands of those in whom the executive does not want information to fall. But it absolutely destroys anything which may be considered convivial or responsible working conditions—hardly the sort of life one would expect intelligent, educated computer technicians to accept.

Escorted to the terminal

IBM, as always, carries security to a high degree. In the description of its Advanced Administrative System, it says: "Normally, management does not allow programmers to exercise their own programs in the real time system. This is to protect them from the risks associated with the ability to exercise blind options to cause the program to do something beyond its intended scope. For example, the job description of the individual who wrote the Sign-on program provides that he will never use the real time system without management supervision."

The implications of this approach must seem horrific to earnest programmers preparing to dedicate their careers to the creation of systems programs—the programs which control and supervise the running of computer complexes. The more they create, the more they will be excluded from using the final system. IBM offers a life sentence of being escorted to the terminal to the current crop of computer scientists. There is no question that a programmer can sneak into the software little goodies for his own

personal use that no one else could discover. But IBM has chosen to fudge round the unscientific basis for program construction by restricting its staff.

Surprisingly, the computer fraternity has been extremely shy in approaching the problem. On the one hand, they want to keep their jobs; on the other, quite rightly, they seek to preserve their self-respect. The solution seems to have been to insist on professional status (and thereby incidentally claiming interests akin to management), rather than to be considered as the clerical and administrative staff they replace.

The rub is that data personnel have by no means been extended executive trust. And as the security industry more forcefully presses its case, computer technicians will find their professional lives more circumscribed. In depth applicant vetting and periodic character reviews are becoming more common, meaning that technicians must not only be docile, but must previously have kept their noses clean. Given another recession with its overstocked computer labour market, there will be even more pressure to conform in order just to remain employed.

More responsibility, not less?

What possible response do data processing personnel have? A good case can be made that the democratic use of computers involves not only executive public accountability, but genuine decentralised, non-hierarchical decision making as well. That is, that those operating computers are partly responsible and accept the consequences for the uses to which they are put.

This smacks too much of trade unionism or worker-participation to interest the computer or security industries. The former are hardly known for their decentralisation. The latter have recruited ex-policemen and army security staff now turning their hands to labour relations. But the British Computer Society seems disinterested as well. Their "Code of Practice" essentially lays down that personnel will work exclusively in management interest—in effect transforming them into their employers' security men as well.

For some time computer security has been sold publicly as the industry's magnanimous contribution to safeguarding privacy. But the public is finally discovering that corporate and government secrecy and industrial privacy are by no means the same. How much longer will data processing personnel be similarly bemused?



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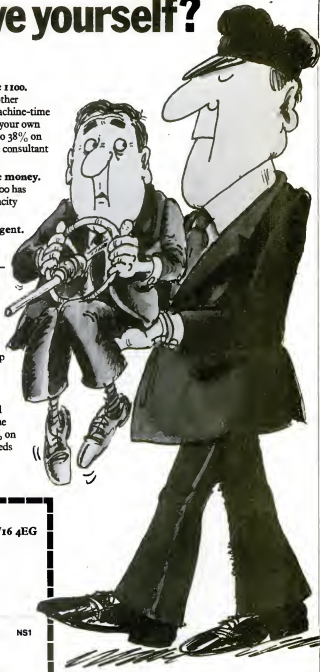
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Developmental psychology forum

Conversations with a two-month-old

Research in America and Britain challenges the notion that babies learn the rudiments of social interactions through exposure to adults. Close observations reveal that it is the infants, starting as young as two months, that largely determine the form of the interactions, even to the extent of directing "conversation" with an adult

Dr Colwyn Trevarthen

is reader in psychology at the University of Edinburgh

Some years ago I began to study infants with the intention of looking for signs of what innate structure of intelligence lay dormant or weakly expressed in them. I knew that human newborns possess huge, elaborate brains, but they were credited with doing very little; this puzzled me. With the aid of modern recording techniques, but especially television and film, I soon obtained data that made me suspect that much of the innate pattern of human intention and a predisposition to perceive and use the world, including people, had been glossed over in scientific studies of infants. Most remarkable were indications that infants of a few weeks of age were showing signs of intentions to speak and that soon after this they were entering into well-organised, sometimes even witty or humorous, conversation-like exchanges with adults.

In a preliminary film study Martin Richards and I, working with Jerome Bruner at Harvard, sought to determine if and when infants developed behaviours indicating that they perceived objects and people differently. We filmed five babies once-a-week from birth until they were six months old, either with a small toy suspended nearly in front of them, or with their mother.

We saw highly elaborate activity that was specific to communicating with persons in all subjects while they were with their mothers. The mother was simply asked to "chat with her baby". No mother thought this an odd request. Her presence, what she looked like, the way she moved, the sounds she made, caused even babies a few weeks old to make behaviours that were different from those made a moment later to the suspended object. The infant showed two different kinds of interest, two ways of spontaneously responding; one for the object, and one for the mother. Most different were the expressions of face, voice and hands. We hypothesised two modes of psychological action: communication with persons, and "doing" with objects. The latter included visually exploring and tracking, trying to grasp, trying to kick or step on, or trying to seize in the mouth (Figure 1).

Since coming to Edinburgh I have made films with Penelope Hubley and Lynne Sheeran, detailed analysis of which reveals that the acts of two-month-olds responding to attentions of other persons outline many psychological processes of conversation between adults. Of these we have found activity which is best called 'prespeech' because both the context in which it occurs and its form indicate that it is a rudimentary form of speaking by movements of lips and tongue (Figure 2). These distinctive movements are often made by young infants without sound. At other times young babies are very vocal, making a variety of cooing sounds as they move mouth and tongue. We note a specific pattern of breathing with prespeech even when sounds are not made.

Also associated with prespeech are distinctive "hand-waving" movements that are developmentally related to the gestures or gestulations of adults in "eager" and "graphic" conversation (Figure 2). We are now sure that, notwithstanding the importance of cultural development in the formation of language, both of speech and of gestures, the foundation for interpersonal communication between humans is "there" at birth, and is remarkably useful by eight weeks when cognitive and memory processes are just beginning.

Communication is the essence

We can now confidently say that communication activity is much more complex than any other form of activity of infants at this age. We conclude that human intelligence develops from the start as an interpersonal process and that the maturation of consciousness and the ability to act with voluntary control in the physical world is a product rather than an ingredient of this process.

Infant communication needs a partner. It depends on a number of special adaptations in the mother's behaviour. Some of these, we find, are almost automatically fulfilled by the normal rhythm and organisation of her voluntary action, others require unconscious

Figure 1
Arm and hand movements in very young babies aimed to objects which they are tracking visually with eye and head show innate "prereaching". These movements occur at a rate close to that of the unconsciously-regulated adult hand-grasp. Eyes, head, arms and hands, and legs and feet are linked in a single system that can be aimed to places in nearby space around the baby's body. This infant is three weeks old





alterations in the way the mother would normally communicate to another adult person (Figures 2 and 3). Changes that all unaffected mothers make to slower, more emphatic but gentle movements and to "baby talk" may come from a return of the mother to more elementary or basic components in her innate repertoire of social acts. It is certain that what she does to guide and sustain the sociable mood of the infant is natural and unconscious, even though mothers and psychologists may have opinions about the effects of treating a baby as a baby. Our charts of the conversation-like exchanges between mother and infants reveal regular patterns in time. By plotting the shift of the two partners up and down a few grades or levels of social animation we find that it is possible to show in a diagram the changing roles of mother and infant. That the mother provides needed stimuli in right measure is clear. Furthermore, infants at this age do not usually take time to mimic their partners—they just play their part.

That young babies will sometimes imitate acts of others appropriately, even when to do so they must move a part of their body they cannot see, has for a long time struck psychologists as mysterious and important. It seems to indicate that babies follow instructions, but it also needs an elaborate innate machinery. Even in the second month a baby may imitate a mouth movement of the mother, or protrusion of her tongue. To do so the baby must have a model of the mother's face in his brain, and this model must be properly mapped onto the motor apparatus of his own face. Movements of head and hands, as well as face may elicit imitation. The baby must have models for these parts as well.

Figure 2
Babies show that they distinguish people and that they are innately prepared to signal their intentions and interests to them; these include prespeech and infant gesticulation



Figure 3
The close correspondence of attitude and expression of excitement, feeling and interest result from the mother imitating the infant, not the other way round. This is a baby girl only six weeks old



In our films we have rarely seen imitation of this kind in babies under six months of age, and when it does occur, the infant is abstracted from the conversational flow and closely regards what the instructor does for some time before acting to imitate. Moreover, the partner must try to get imitation by pointedly repeating an act in a teacher-like way that is not a common behaviour of a mother to a young infant. On the other hand, we are impressed with the elaborate and faithful mimicry of the more animated acts of the baby by the mother (Figure 3). Apparently her imitation is an important part of the normal encouragement to conversational activity by the baby.

Psychological communication

Discovery of embryonic speaking in the social animation of infants, nearly two years before they use words to communicate, reinforces the view of psycholinguists nowadays that language is embedded in an innate context of non-verbal communication by which intention and experience are transmitted from person to person. As the Oxford philosophers Austin, Grice and Strawson have established, we speak with obvious purpose to inform, instruct, direct or in some other way influence the actions and experience of others. The meanings of single words depend on their position in such speech acts. Infants a few months old make speech-like patterns of movement when they are also clearly overcome by some rudimentary purpose to influence, impress, or lead the attentions they have obtained of another. Even though no meaningful information about the world is transmitted, the act is clearly one of psychological communication that may be said to show "intersubjectivity".

Mothers "talking with" infants about two months of age show phrasing of their speech to allow the infant to take his turn and "have his say" in prespeech. Much of the behaviour of the baby expressing excitement or impulse to act is followed closely by the mother, and indeed her skill and understanding of what the infant is doing enable her often to obtain synchrony of emphatic acts so the two behave in complete concert as if dancing together. But, this does not apply to prespeech which is normally watched, with little sign of imitation or shadowing.

The use of speech to name and talk about experiences in the common field of things, people, one's actions, or the actions of others, comes much later in life, after a considerable development of exploratory and manipulative intelligence, and when free locomotion is beginning. Jean Piaget concludes that this proves the primacy of the development of schemata to know objects. It may, as Joanna Ryan of Cambridge proposes, indicate the need for considerable development of intersubjective communication without words, before words can be used to signify and specify.

The early appearance of communication with persons in the psychology of infants seems to provide what is needed for sharing all kinds of action and purpose with adults as more capable, more intelligent beings. At first infants seem fully occupied with the formalities of the interpersonal play. But, after four months, developments in attention and object recognition, and particularly the development of controlled voluntary reaching for and manipulating and mouthing objects, means that a conversation can become about what the infant has looked at, reached to, done. This is the beginning of games with things, or "toys"

Preparing the way

We believe that all play has an interpersonal element, although this may be disguised in private games when the self plays with itself. Peter Wolff of Boston has studied the earlier purely social play a mother can have in peek-a-boo or pat-a-cake with infants as young as six or eight weeks. This communication prepares the way for play with things.

If an infant of four months or so reacts to the attentions of an adult by looking pointedly at or deliberately reaching for or pointing to something, this thing becomes at once the centre of interest of the partner too. Around five months many of the infants we have studied have exhibited a marked increase in such deliberate bringing of a topic from the outside into a "conversation". They seem to do so more with highly familiar partners, such as their mother, than with mere friends who, unlike strangers who threaten at this age, may be treated with undivided "conversation".

This is the age at which it is first possible to show a baby something one is doing, and it is also the age at which strong attention to the mouth of the mother leads a baby to imitate some of her speaking movements. Clearly such developments have great significance as preparation for the growth of

language as communication about intentions and experiences with reference to people, places and things.

Many studies have sought to trace recognition of the mother as a particular person, or as an object with an identity, or conversely, to find when babies will show fear of strangers. Most of these record a critical change at about four or five months, and at present psychologists usually attribute this to an advance in learning powers or cognitive processes of the infant that enables better perceptual discrimination of strangers and friends. Psychoanalysts insist that this change is also a development of the affectional process—that love of the familiar caretaker is involved.

But at this same time infants frequently do not wish to play at conversation with their mothers, but will still do so with less familiar friends. Our evidence suggests that there is a relationship between a new willfulness in social behaviour and the emerging intentions to take hold of and manipulate things. Entirely new levels of memory and perception process develop along with the appearance of effective actions on objects, and these advances are coupled to equally significant changes in the kind of dependency the infant has on the actions of others, especially those people for which a special attachment is forming.

A basic inateness of personal reactions in man is shown not only by the timetable of growth of functions common to all normal babies, but also in individual differences. Adults differ in personality and they behave in widely different ways with infants, some being shy and fearful of even a manifestly friendly baby; and fathers differ in important ways from mothers. We have some evidence that some fathers play a more boisterous kind of game with more jokes and mimicry of prespeech grimaces and more poking of the body than do mothers. They thereby excite infants more to calling and laughter, and to vigorous body movements. It has been found that fathers treat infant girls with more talking and gentle touching than boys with whom they are more peremptory and sometimes very vigorous. But even very young boys and girls act differently, too, showing that such sex differences are not entirely due to learning of social roles. Male babies only two months old generally have more vigorous body movements and adopt more readily a leading place in a conversational exchange with their mothers (Figure 3). Female babies tend rather to watch and follow and to act in animated face and mouth displays with fine hand gesticulation (Figure 2).

It seems very likely, from our few case studies of individual parents with infants, that there are also large inherent personality differences between adults or babies of one sex that affect the pattern of intersubjective behaviour. We need to do much more work to describe types of personality in very young persons.

One recent outcome of our work on intersubjectivity in early infancy throws light on the relationship between emotion and the



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acts that infants address to persons, a topic which is of central importance in Freudian theory of infant development. An undergraduate student John Tatum has performed an experiment in my laboratory on the emotional effects on an infant when a mother acts irrelevantly. He arranged, with a partial reflecting mirror and changing lights, for the mother, while remaining visible to the baby as before, to cease seeing the baby and to see an adult in the same place. The person silently asked the mother questions by holding up cards with writing on them. The infant could see only the mother. In replying at length the mother automatically changed her style of talking to that appropriate for an adults from that proper for her baby, and of course, also stopped reacting to what the infant did.

In every case the eight to 10-week-old infants were clearly puzzled by the change in their mother, and they made exaggerated solicitations as if to get her attention back. Some quickly became dejected looking and withdrawn, a state of acute depression which took minutes to abate when the mother's attention returned to the infant with a change in lighting.

Dr. John Bowlby of the Tavistock Institute of Human Relations, London, has collected abundant evidence since the last European war of the depressing effects of departure or loss of a mother, or other principle companion, on the health and spirits of babies and children. He believes initial attachments are innate, but based on a few social release mechanisms like those studied in animals by Konrad Lorenz and Harry Harlow. Tatum's experiment shows how complex is the relationship between person perception and emotion while a very young baby is actually communicating with a person. Obviously the basis of interpersonal relationships is highly complex and emotional from birth.

Our findings lead us to question accepted views of the socialisation of human intelligence. Jean Piaget, who believes in a strong, developing biological determination of the human mind, conceives of infants as initially unaware of the separateness of themselves from the world they experience. Out of this union with experience they "objectify" both things and persons without distinguishing these two. He has said, however, that *following* the development of the brain schema for an object "objects are conceived by analogy with the self as active, alive and conscious", and that "this is particularly so with those exceptionally unpredictable and interesting objects—people". Piaget thinks that in the first few months there are no signs that infants respond particularly to persons as such except reflexly, and that infant emotions are determined by affective reflexes triggered by simple losses or gains of equilibrium. Like Sigmund Freud he attributes the foundations of human social experience to biological needs of the self.

Freud thought these needs were derived from feelings of the body important for physiological maintenance, but also gave great importance to the development of affectional

functions that define an 'object relation' with the mother early in the first year of life. As we have said, John Bowlby, who is a psychiatrist and psychonanalyst, accepts the ethologists' idea of attachment through innate releasers in adult and baby, and imprinting of the baby to a particular person who is usually the mother.

Rudolph Shaffer of Strathclyde University, Glasgow, says "An infant is essentially an asocial being", that "other people, he soon finds out, are fascinating things to watch, feel and listen to, but as yet they do not constitute a class of stimuli distinct from the inanimate world" and that "children are not born 'knowing' people".

But, our films show that infants are adapted, at the latest by three weeks after birth, to approach persons and objects quite differently. The elaborateness of their social responses and social expressions in the second and third months, before they have begun deliberate and controlled handling and mouthing of objects, indicates that intersubjectivity is fitted into development from the start as a determining influence. Human social intelligence is the result of development of an innate human mode of psychological function that requires transactions with other persons. This function includes rudiments of the quite unique human activity of speech, which becomes the chief medium individual human mental growth and the essential ingredient of civilised society.

Interaction and communication

I believe that evolution of experimental or scientific thought processes in the mind of a child, and the object-perception processes associated with them, may develop at times in competition or disequilibrium with the growth of intersubjectivity with persons. But, I also feel certain that the normal development of cognitive mastery of the world is one that advances through co-operative interaction of private experiment and social communication. Neither is sufficient alone.

Humans project their minds into the world to invest objects and events with intention, not because they confuse themselves with the world, but because they have such a fundamental gift for communication with intentions of persons that mirror themselves and that they may mirror in reply. That such abilities are biologically founded in man suggests they have a determining role in the plan of growth and the changes in the life of individuals. I believe this concept of a growing innate social function will prove necessary to understand the co-operative efforts of humans of different ages in families, in schools, in business, in sport—anywhere where people create mutual activity.

At this point neurobiological considerations which encouraged my initial enquiry into infancy have receded far into the distance. Now I am involved in psychological considerations for which known anatomical schemes are unhelpful. Specialised nerve networks in orderly arrays must be there, but I have not the remotest notion of how or where they may be specified in the brain.

Civilised carve-up in Caracas?

The need for an enforceable international consensus on laws governing ocean exploitation is likely to soften the horse-trading at the UN Law of the Sea Conference in Caracas this summer

Tony Loftas

The Third United Nations Law of the Sea Conference takes place this summer at Caracas, Venezuela. The two-month long conference has before it a massive agenda, with some 90 items arranged under 25 heads and ranging from the width of the territorial sea to the right to freedom of research. It will be the largest conference of its kind ever held and takes place at a time when marine resources and the rights of individual states, both rich and poor, are of paramount interest to the world community. Fourteen years have elapsed since the second conference, which, if anything, was remarkable for its failures rather than successes. The first Law of the Sea Conference, held in Geneva in 1958, was more successful, but many of the issues that went unresolved then and in the subsequent meeting will be placed before the Caracas conference.

Since the last conference, many new nation states have been born. Even more states, particularly the developing countries, have become better organised on the issue and are committed to taking an active part in the formulation of international law of the sea. Much of the credit for this new commitment must go to Malta which through the energy of its UN delegate, Dr Arvid Pardo, made nations aware of the threats posed by the great powers' domination of the oceans and the sea-bed in particular. Following Pardo's address to the General Assembly in 1967, an ad hoc committee was formed to study the uses of the sea-bed beyond territorial waters, an area proclaimed to be "the common heritage of mankind". This ad hoc group led to the formation of a Sea Bed Committee, within which the Preparatory Committee for the Law of the Sea Conference was formed.

Slow progress

Events within the Sea Bed Committee have underscored the differences between countries. Progress has been slow and made possible largely by reaching consensus agreement rather than putting matters to the vote. Nevertheless, in the past two years the mood of many states has changed, paving the way to conciliation and compromise. They realise that political trade-offs may be necessary to attain majority support. The maritime powers, for example, could be out-gunned by countries that do not share their preoccupation with traditional freedoms of the sea. Similarly, the aspirations of countries that would benefit greatly from the seizure of large expanses of sea and sea-bed off their shores could be thwarted by the land-locked (no sea), shelf-locked (limited sea area) and narrow-shelf (little shallow sea area) states.

The proposal that the oceans beyond the territorial sea are the common heritage of mankind is accepted in principle, but just what this might mean in practice remains

obscure. Fundamental to the issue must be the limits set to the area to be used for the benefit of all mankind. Fixing the resource wealth of the common heritage will help to decide the appropriate legal and administrative regimes. Talk about regimes without reference to the potential wealth or poverty of the common heritage belongs to cloud cuckoo-land or to that favoured political stragem whereby states agree in expansive legal phrases not to do what they had already decided was pointless anyway. Although the UN General Assembly resolution which set the priorities for the conference described questions relating to the high seas and territorial waters as "related" issues, they are in fact central to the main issue.

The width of the territorial sea is almost inextricably caught up with the exploitation of marine resources and other uses of the seas, particularly as thoroughfares for international trading and theatres of military deployment. On the whole the advanced military and/or maritime nations have favoured a narrow territorial water with a further relatively narrow "contiguous zone" in which they could exercise certain rights such as limited policing and exclusive fishing. A different attitude was adopted, however, for mineral resources, principally hydrocarbons, on or in the sea-bed. In this case, they invoked the Continental Shelf Convention of 1958 to lay claim to the sea-bed to a depth of 200 metres and even beyond where their technology permitted exploitation. An attitude of open hostility was adopted towards those states that, lacking any continental shelf or mineral resources to speak of, adopted a broad limit reaching out to 200 miles to retain exclusive use of rich fisheries off their coasts.

To some extent the fight for narrow territorial seas—contiguous zones was doomed to failure once many developing countries realised the potential assets at their doorsteps. Increasingly the trend, spear-headed by the Latin American coastal states, has been towards an exclusive offshore zone called by various names extending a distance of at least 200 miles. The problem now, as seen by the maritime powers, is to keep the territorial sea to no more than 12 miles while preserving the right of passage through the many straits which would then fall completely within territorial waters. The question of resource control, both living and non-living, is perhaps of less concern in a situation where bilateral fishery agreements are possible and where many of the principal beneficiaries of wider sea-bed ownership are, in fact, developed countries.

Next in the pecking order come the land-locked and shelf-locked states. They object to other nations sharing out the richest parts of the marine real estate. Many coastal states

in Africa, for example, are pressing for a 200 mile wide exclusive economic zone (EEZ), but what of the 14 African countries that are land-locked? Through the Organisation of African Unity, the coastal states have suggested that these countries should enjoy right of access to the sea and are entitled to share in the exploitation of living resources within the EEZ on an equal basis with nationals of the neighbouring coastal state, subject to appropriate bilateral agreements. The coastal states are not so magnanimous when it comes to mineral resources, however. They regard the submerged land mass as belonging to, and an extension of, the land territory. In such circumstances many land-locked and underprivileged coastal states might well prefer only the narrowest of coastal strips being given over to exclusive national occupation or exploitation.

Developing countries share a common concern over scientific research carried out by foreign scientists in or close to these coastal waters. A distinct dichotomy exists between the advanced maritime powers, with sophisticated hydrographic offices and marine research programmes, and those countries with little or no marine research expertise. The poorer countries suspect that knowledge gained by their scientists places advanced countries at an advantage should these waters be made available for exploitation. Furthermore, with evidence of military espionage and the close association that can exist between civilian and military oceanography, some states at least, feel that their national integrity may be threatened. In contrast marine scientists tend to regard such comments with disbelief that would be good humoured were it not for the fact that their research is often delayed. International law is regarded as an albatross about their neck. Nevertheless, the prognosis suggests a gradual if not complete erosion of the freedom of research over an increasing proportion of the marine world.

Restrictions on marine research contradict the parallel need for the environmental data needed to protect the marine environment, which is a major item on the agenda of the Caracas conference. No-one knows, for example, what effect deep-sea mining might have on the marine environment, nor can the outcome of disputes over the right to own or exploit mining resources be predicted.

The exploitation of living resources poses a particularly troublesome problem for the conference. International fishery commissions already exist to manage and conserve particular fish stocks or marine areas, but they have often proved ineffective in the past. In any case, they are generally under-powered both financially and legally. Apart from those coastal states that have already solved the problem by claiming extensive territorial waters or fishery zones, others are attempting to protect their coastal resources while retaining the right to exploit resources elsewhere. This involves the neat but dubious ploy of designating some species as coastal, some as oceanic, and others as andromodous—fish such as the salmon that move between ocean

and freshwater environment. Such a view appears to spell doom for oceanic species such as the tuna and some marine mammals unless exploitation is effectively regulated. Whether this control should be in the hands of strengthened or new fishery commissions is debatable. If an international ocean authority can manage oceanic mineral resources, why should it not control the living resources as well?

What kind of regime?

Since the 1970 UN Declaration of Principles governing the status of the international sea-bed area, a dozen or so national proposals have been put forward for a sea-bed regime. Three basic issues are obviously at stake: the area to be governed by the regime; the legal nature of the regime and its relationship with coastal states; and, finally, the nature, structure and function of the regime. Crucial to the discussions once the area of the international jurisdiction is determined, will be whether the authority is to be merely a licensing body or an operating authority capable of exploiting either directly or through sub-contract the mineral wealth of the oceans even perhaps to the extent of marketing and distributing income.

Following on the 1970 declaration, most states acknowledged that the proceeds from exploitation of the common heritage should be divided according to need. Furthermore, this distribution, whether in cold cash or access to resources, should not discriminate against land-locked countries and underprivileged coastal states. Assuming that the greed of coastal states does not prove so excessive as to deny the regime real resource wealth and that an ocean authority can be created, the major problem of how to distribute the proceeds must remain. What criteria would be used: population, gross national product, geographical location, state of development or a combination of these? Will the developed countries, already reeling from the recent oil manoeuvres, feel inclined to release a technological superiority that offers immunity from the manipulations of major suppliers of other essential raw materials?

After the Caracas conference, whether the major issues touched upon here are resolved or not, things will never be the same again in the marine world. The world has had to wait too long for the third Law of the Sea Conference. The Caracas gathering cannot solve all the legal issues, but the ultimate goal must be a coherent body of law acceptable by all nations: there can be no out-right victors or losers, nor should troublesome issues be isolated for the sake of political expediency. This need for general acceptability is important: none of the four Conventions signed at the first Law of the Sea Conference, for example, have achieved more than 60 ratifications to date. If the conference fails completely and does not provide for a continuing dialogue, then a land race unparalleled in history could be set off. There is no doubt who would be the winners, but the entire world would eventually prove the loser.



Computing graduate job prospects

A "computer dating" service for bringing together graduates and employers is now in its third year. In addition to fixing jobs for students, it is also providing new data about the British manpower market

William Prentice is chairman of the Computer Assisted Placement Service's steering committee

Travellers in the London Underground may often find themselves opposite an advertisement for a computer dating service. But few of them probably know that a dating system is now well established in the graduate recruitment field. This is the Computer Assisted Placement Service—or CAP Service to give it its usual name. During two runs, in November and December last year, about 10 000 students entered their job preferences into a computer program to have them compared with 9000 vacancies entered by employers—representing industry, commerce, government and public corporations. Students received a "top 20" vacancies and employers received a "top 50" students for each job entry.

The CAP Service was developed because the number of degree-awarding institutions, the range of degrees offered, and the number of graduates have all been increasing in recent years. In addition, many new employers have entered the graduate recruitment market. As a result it became impossible for the student to study all the literature available in his careers advisory service. Likewise very few employers could afford to visit every university and polytechnic.

In 1969 a working party representing university appointments officers and professional recruiters was set up to study these problems. This working party reported to a conference at Leicester University in 1970, proposing the setting up of a cooperative venture to computerise part of the traditional recruitment process. The proposal was accepted by the two sponsoring bodies—the Standing Conference of University Appointments Services (SCUAS) and the Standing Conference of Employers of Graduates (SCOEG)—and a steering committee consisting of representatives of SCUAS, SCOEG and the National

Union of Students, was established to conduct a detailed feasibility study.

The Steering Committee reported favourably to the 1971 SCOEG Conference at York University, as a result of which it was empowered to implement the scheme. Two appeals to SCOEG members produced £7000 which paid for the feasibility study and the subsequent systems analysis. The computer program was financed by a bank loan of £15 000, underwritten by employer participants. Operating costs, including amortisation of the loan, are covered by fees paid by employer participants.

With the help of a professional systems analyst, a sub-committee designed a system. The tender for writing the program was won by the National Data Processing Service (NDPS), a subsidiary of the Post Office which is obliged by Act of Parliament to preserve the confidentiality of clients' data. As implementation approached, an administration had to be established. Thanks to the cooperation of Manchester University, the full-time services of Marcus Cassels were obtained on secondment from their Careers and Appointments Service. Geographically also the location is ideal, as the punching contractors are in Manchester and the Computer Centre in Bootle.

The pilot run commenced in September 1972, just 15 months after the decision to implement the scheme. Fifteen representative universities were chosen according to geographical location, size and type—classical, redbrick and plate glass. Together with one polytechnic they provided the institutions from which 4000 students took part. Of the 100 employers who paid up initially, only 93 could enter jobs, owing to the drop in graduate recruitment. The pilot run focused entirely on the "milk round", three separate matching runs being carried out during November, December and January respectively.

The run was completely successful from the technical and administrative viewpoint, which was most important, as any breakdown in the "mechanics" at this stage could well have killed the project. To assess the qualitative viewpoint, questionnaires were distributed to employers and appointments services and to 10 per cent of student participants. Careers and Appointment Services were very enthusiastic about the marked increase in the use made by students of the careers information available. Large numbers of students seemed to have adopted a more systematic approach to career choice. However, the students showed a mixed reaction. Some were very enthusiastic because they found unsuspected job opportunities. Others were dissatisfied because they did not find the opening they wanted. Sometimes this was due to the pilot run not being completely representative; sometimes because the jobs did not exist or

How the CAP Service works

Each student completes an entry form, choosing for eight criteria the codes which best describe what he has to offer and the kind of job he would like. These criteria are:

Type of work	Location of job
Academic subject	Type of employer
Qualification	Mobility
Activity of employer	Sex

The student must also assign a weighting which represents the relative importance of each criterion.

Employers complete an entry form with the same criteria and a similar weighting system. Criterion 1 is a compulsory GO/NO GO, that is to say, if employer and student do not agree on type of work, there is no point in proceeding. Employers also have the option to assign GO/NO GO restrictions to two other criteria, thus preventing an inherently unsuitable job/student combination from reaching the printout stage.

During the run, each student entry is compared with each job entry and, provided the GO/NO GO criteria are met, a score is calculated for each student/job combination by summing the products of the weighting factors for each criterion. The scores are retained separately in the computer memory for students and jobs at the end of the run are printed out.

Types of work requested by physics and chemistry graduates

	Chemists	Physicists
Research and development	40%	43%
Technical services (laboratory)	14	3
Product/process development	8	2
Management services	4	7
Production supervision	4	2
Accountancy	3	3
Administration	3	2
Health services	3	4
Information science	3	2
Marketing	3	2
Teaching	3	3
Computer programming	2	6
Physical distribution	1	3

not in sufficient numbers. Some employers reported reduced numbers but higher quality of applicants. Some reported a wider range of applicants than previously. A few could find no clear benefit or even some disadvantage.

Perhaps the most realistic assessment is to study year 2. The number of institutions went up from 16 to 61, indicating that the enthusiasm of the pilot run participants had infected the others. There are now only a handful of universities and polytechnics where the service is not available to students. The number of employers went up by 20 per cent in year 2. Moreover, the average number of vacancies per job entry has increased, resulting in 50 per cent more vacancies. About 70 per cent of employers who took part in the pilot run came into year 2.

After nearly two years of operation, several side effects are emerging. The need to complete an entry form is forcing students to think about their career more rationally, to begin thinking earlier, and to make more effective use of information available. The encoding of a job description demands a similar assessment of needs, a discipline welcomed by many recruiters particularly as it forces line managers to describe their requirements more specifically than, "just get me another chap like Bloggins".

A further valuable side-effect is the provision of quantitative information which was not previously available—for instance, supply and demand for each "type of work". It must be emphasised that the figures are incomplete and crude, both by the nature of the estimates and the element of double-counting in both supply and demand. Nevertheless, provided due caution is observed, useful information may be extracted.

The total numbers of vacancies and student entries are comparable and there is a tolerable balance between supply and demand for many types of work. However, the two groups below exhibit an unbalance of 2:1 or greater:

1 More students than jobs—administration, health service, information services, management services, technical services (laboratory);

2 More jobs than students—accountancy, design and construction, marketing sales, engineering graduate apprenticeship, management trainees.

It is of course unwise to put too much weight upon these findings, but they cast some doubt on previous claims that students

want challenging jobs with early responsibility; the above figures would suggest that students prefer service type jobs with little personal responsibility.

The CAP Service also throws some light on the preferences of students studying different disciplines. The types of work requested by a sample of 800 chemistry and 700 physics graduates and postgraduates are shown in the Table.

The service has come a long way in two years. Where does it see itself going in future? Already planned is an experimental run in May/June this year to cater for students who are still unplaced and for employers who have unfilled vacancies. This run should be particularly useful for employers who do not visit universities in the spring, whether because they feel their needs are too small, or because they cannot forecast needs so long in advance. If this run is successful, more out-of-season runs will be made in year 3.

Future developments

The service might also be extended in directions such as postgraduate awards, vacation employment, teacher training college places. Yet another method of extension might be to include HND holders, which would greatly increase the numbers of both students and institutions.

There is also scope for improving the "peripheral" part of the service. For example, with the considerable degree of mutual trust now established, students will be asked next year to fill in a standard form of supplementary information. On receipt of their printouts, an employer will be able to request photostats of these forms completed by student applicants who interest him, before actually writing to them.

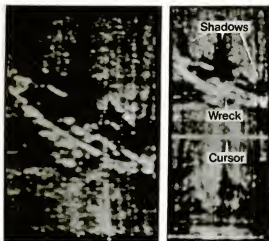
One of the most remarkable features of the CAP Service is the way it has been developed by a diverse group of people whose only common link is their involvement in graduate recruitment. They have shown that it is possible for such a group to carry to a successful conclusion a venture which is somewhat removed from their normal role, provided that they keep to a common objective; collectively possess most of the types of expertise needed; recognize the skills they lack and obtain expert advice, paying for it if necessary; keep closely in touch with the interests they represent.

The day-to-day running of the service is carried out by the general-secretary and his staff. The general policy decisions are firmly in the hands of the Steering Committee, which is appointed by the parent bodies. The development of general policy decisions into the implementation stage is carried out by a liaison committee consisting of the general-secretary and the chairman, vice-chairman and two members of the Steering Committee. By sticking to its original maxims and using well-tried—if unorthodox—methods, this group hopes to continue to provide the various parties involved in graduate recruitment with a service which is both economical and tailored to their needs.



Technology review

Sonar birthday present for Marconi



A sea-bed wreck as seen by "Hydrossearch" sonar. The new system, originally designed by the Admiralty Research Laboratory, lists the wreck's length, beam, and height, as well as measuring the depth of water above it

An £800 000 contract to develop high definition sonar for underwater surveying and offshore operations has been awarded by the Department of Trade and Industry to GEC-Marconi. Under the contract Marconi will deliver by 1976 two "prototypes" of the advanced sonar equipment originally designed by the Admiralty Research Laboratory at Teddington.

The DTI cash will be channelled through the Ship and Marine Technology Requirements Board (SMTRB) which has been under some fire in recent months (particularly at the hearings of the Select Committee on Science and Technology—

New Scientist, vol 61, p 404). The Board's first annual report, to be published in a few weeks, says that SMTRB spent only £1.5 million on "non-ship" technology in the fiscal year 1973-4. Of this £1.5 million was spent on what Nigel Brookes, the Board's chairman, calls "the more creative end of the spectrum". The SMTRB budget is likely to be increased by something like £2 million this year. Nevertheless, a contract of £800 000 is clearly a sizeable chunk of what many critics see as limited funds.

The need for new sonar technology to improve the mapping of the sea-bed has been recognised for some time—in par-

ticular by the interdepartmental Committee on Marine Technology set up following a White Paper in 1969. The need arises basically because of the ever increasing size of merchant ships in general, and tankers in particular. For every extra foot of a tanker's draught, 4000 extra tonnes of oil can be carried, making £25 000 a year for the operator.

But supertankers demand that the sea-bed be surveyed more closely than ever before to provide charts that accurately locate obstacles. An increase in the area of sea surveyed is also required. Whereas surveys to the 11 fathom line (about 20 metres) used to be acceptable, these now have to be extended into waters as deep as 120 ft (about 40 metres). The explosion of interest in offshore engineering has also prompted the search for better sonar.

The equipment developed by the Admiralty gives 100 per cent coverage of the sea-bed. Instead of surveying water depth along sounding lines (which may be 240 m apart), the sonar scans the whole area, and electronically translates the scan into a dual display (see photograph). The sonar works in two "modes". In the forward mode, a 30° sector ahead of the surveying ship is scanned at a range of 370 m. When an object such as a wreck on the sea-bed is picked up, the sonar beam can be switched through 90°. Two pictures are taken of the object from the two angles. From these the ship-board electronics builds up a profile of the wreck, detailing its length, beam, and height at bow, stern, and midships. Marconi says that in trials, the sonar resolved targets only 0.9 m apart at a range of about 200 m, and measured depths with an accuracy of better than 0.6 m at 200 m. The system also produces a vital piece of information—the depth of water over any obstruction.

Critical response to plutonium report

The controversial report on the plutonium "hot particle" issue prepared by Arthur Tamplin and Thomas Cochran is heavily criticised in an 11-point review prepared by the National Radiological Protection Board (NRPB). Tamplin and Cochran (New Scientist, vol 61, pp 542, 612, 795) maintain that the permitted levels of plutonium released from nuclear establishments are far too high (by a factor of more than 100 000) for safety. They argue that the method of drawing up exposure standards by averaging the dose from a single plutonium particle over the whole lung leads to a too low estimate of the risk of developing lung cancer. Tamplin and Cochran claim that anyone who ends up with a single plutonium particle in his lungs can almost be guaranteed to develop lung cancer. The NRPB maintains that there are

a number of errors in the Tamplin and Cochran report. To begin with: "It should be noted that no human cancers have been positively associated with exposure to insoluble particles or soluble compounds of plutonium. Hence the findings of the Report are based on implication or extrapolation from animal experiments."

The NRPB is disturbed by the way Tamplin and Cochran change wording. In particular, the NRPB notes that the phrase "a similarity to known pre-cancerous epidermal cytological changes", which is correctly quoted when first mentioned in the Americans' report, becomes "pre-cancerous changes in human tissue" when the second mention crops up. Ultimately this becomes "particle induced cancer", which the NRPB describes as "the old trick of progressively chang-

ing words to arrive at a dramatic conclusion".

In another criticism, the NRPB points out that radiation experiments on rats by one research team did not produce the same effects when a second team repeated the experiments with mice. "If extrapolation from rat skin to mice skin is not possible in this work, then little confidence can exist in the extrapolation from rat skin to human lung tissue."

Other experimental results contradict the hot particle theory. For example, one researcher "has reported greater toxic effects including cancer in rats following deposition of curium-242 in lungs compared with equal amounts of plutonium-239 activity. This he attributes to the diffuse nature of the curium deposit and the particulate nature of the plutonium. This is in direct contradiction to the Tamplin and Cochran hot particle hypothesis".



NOAA's laser radar system scans the skies. The large barrel pointing to the heavens is the receiving telescope which hides an infrared radiometer

Laser watch on the skies

What the US National Oceanic and Atmospheric Administration calls a "unique" device for the remote sensing of clouds and for measuring atmospheric pollution will soon begin operation after its first field trials and a refitting.

The device is really a combination of different sensing techniques—some derived from space technology, others from more Earthbound ideas. Developed at NOAA's Boulder laboratory in Colorado, the sensing system consists of three main units—a lidar system (lidar is the laser equivalent of radar), short-wave radar, and an infrared radiometer. The system is unique not because of any single new sensing equipment but because it is the first unit to combine these three measuring techniques.

According to Vernon Derr, who directs the research programme at the Boulder laboratory that will make use of the new unit, one advantage will be that the device will avoid serious field tests of lidar as a remote sensing tech-

nique. "Lidar," he says, "is one of the really promising remote-sensing instruments because it behaves something like a highly sensitised human eye. But there is less certainty about how that promise is to be realised."

The new apparatus is composed of a lidar which can use any of a range of laser types, a 70 cm telescope as a lidar receiver, a microwave radar scanning the same path as the laser to detect aircraft and to determine cloud thickness, and an infrared radiometer to measure temperatures.

These are all mounted along the optical axis of the receiver lens, as is a video TV camera which allows the operator to watch the section of sky he is scanning. The laser pulses transmitted from the lidar are routed through a Coudé path so that the beam is uninterrupted by vertical or horizontal rotations of the mount.

The sensing system was used last November in Denver as part of an Environmental Protection Agency programme and has now been refitted ready for a new session of research activity.

are seriously considering this alternative on the Paris-Lyon route. The capital cost of an electrified line would, however, be considerably more than for the turbo-train; an electric line would raise construction costs from £140 million to £231 million. Rolling stock would also have to be modified for an electric service: replacing four turbines connected to an alternator by a transformer and rectifier would mean slightly increasing the length and weight of the driving unit. French engineers, however, are confident that the catenary wires they have designed are suitable for electric trains running at high speeds—up to 320 km/h.

Whatever happens the new Paris-Lyon line will be built and the turbo-train will come into service in 1980 as planned—even if the line is electrified, some turbo-trains will still run.

Sub-titles for the deaf

Deaf people in the US may soon benefit from a simple system that provides sub-titles for regular TV broadcasts. The "captioned TV system" has been developed by the US National Bureau of Standards (NBS) and the Department of Health Education and Welfare. It is now on show in the US at a Smithsonian Institution exhibition in Washington.

There are TV programmes in the UK that are sub-titled for the deaf—BBC 2's news review on Sunday night, for example. But the US system provides similar sub-titles at the bottom of the TV picture for all normal programmes. The captions are sent in code along with the picture and are translated onto the screen by a decoder circuit. Regular programming is not affected in any way as long as the decoder is not activated.

It is estimated that the new device could help tens of millions of Americans with hearing defects. A petition has been filed before the Federal Communications Commission asking for permission to broadcast the coded captions. If this is approved, the National Bureau of Standards will begin a cooperative venture with TV networks and manufacturers. Decoders for the caption network would essentially have to be provided with new TV sets. The cost of a decoder is about £50 but, says NBS, "should decrease materially over the next five years". To convert existing TV sets however would be considerably more expensive.



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Second thoughts about the French supertrain

Because of the energy crisis French railway authorities are taking a long, hard look at the famous French supertrain, the turbotrain. Although TGV-001, the first turbotrain driven by aviation jets, has passed all tests with flying colours, and will clip two hours off the Paris-Lyon route when it begins work in about 18 months, the train will now cost far more than original estimates.

The reason for the increase is simple—fuel for the turbotrain represents 40 per cent of the cost per passenger kilometre. The oil crisis means that the turbotrain will now be as much as 16 per cent more expensive than initial budgets allowed. The running costs of an electrified line are much less, and the French railways

New language to make minicomputer men independent

Minicomputer users have been presented with a new language designed to make them independent of machine manufacturers. Computer users can easily be "locked in" to one particular make of machine. Machine suppliers are naturally not unhappy about this situation. And even though computer users frequently complain, they rarely do anything very dramatic about it. Basically, the locking-in phenomenon arises from the necessity for cost-effective programs to closely match the idiosyncrasies of machine characteristics.

The US Navy, some 15 years ago, created a standard programming language for business in an effort to secure "machine independence". That attempt eventually became Cobol, which is now widely used in business. But Cobol has limitations stemming from the need to be supported by features such as a filing system which is not specific to Cobol, but attached to the way the hardware organises the flow of files through various kinds of storage mechanisms.

But for the users of the new breed of minicomputers the position is very much worse. Minicomputers depend for their remarkable cost/performance on the use of programs which are closely knitted to the features of each machine. Thus the final position for minicomputer users has been very poor. Real time and communications-linked computing necessitates dealing with streams of data as and when these streams arise. The machine

must be responsive without delay and this has seemed to finally lock minicomputer users to massaging the machine so as to coax rapid responses.

In the UK, there are now at least two powerful tools available that attempt the climb to independence from minicomputer manufacturers. Both are high level programming languages that attempt to operate independently of machine quirks. Although one of them—Coral 66—has been available for some years, the other—RTL/2—was launched last week (although RTL/2 has been proved within ICI for two years).

ICI developed RTL/2 partly to achieve machine independence, but also to speed up the production of minicomputer systems. The ICI record shows that RTL/2 cuts programming effort by about two-thirds, even on the first experience of using it. ICI has also shown that RTL/2 can be used on six different types of minicomputer.

Users can choose either to produce programs by compiling on the mini-machines, or use large IBM and ICL hardware to evolve programs that will run on the minimachines. Since ICI is not in the computer service business, it has done a deal with SPL International covering the UK and western Europe. Continental opportunities for RTL/2 are almost boundless as hundreds of PDP-11 processors from Digital Equipment Corporation are being delivered every year. The PDP-11 is widely used in ICI and

is fully tooled up with RTL/2 software. SPL's estimate is that there will be up to 200 installations a year of RTL/2 by 1978 in western Europe.

However, it must not be forgotten that Coral 66 has a head start over RTL/2. Coral comes from the UK's defence establishment computer breeding grounds, whereas RTL/2 comes from the Corporate Laboratory of ICI. As a programming language RTL/2 is much more advanced and elegant than Coral: the effort needed to switch RTL/2 to a new computer is about 6-12 man-months. The comparable figure for Coral is probably higher.

However, Coral is backed by the big guns of the UK's defence and telecommunications computing industry, both makers and users. RTL/2 will probably appeal most to users who put their trust in products from the US-based big league of minicomputer makers. One of the problems facing ICI and SPL in effectively marketing RTL/2 is to persuade computer users that the product has a long and stable life in front of it. For the Coral camp the marketing problem is more of setting up a general shop window and support organisation which carries credibility with general commercial buyers.

With a bit of luck European users will gain from both products. But if the two become too readily seen as rivals, the user may lose the opportunity to gain machine independence while playing a waiting game to see which tool comes out on top.

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Falling computer costs bring new look at digitising

Although map digitising has been around for five years or more, it has, until recently, been dismissed as an expensive toy for the buffoon. But plummeting computer memory costs and increased interest in computer-based information systems have forced management to take a new look at digitising. The fresh interest was made clear last week at an advanced seminar on digitising at the Experimental Cartography Unit (ECU) at the Royal College of Art, London. The seminar brought together environmental scientists, industrial users, and government representatives.

Digitising is the process by which points and lines can be converted into strings of (x,y) coordinates for storage in a computer. Once in the computer, the coordinates can be added to other data and manipulated in various ways to produce totally new maps.

The real interest, however, is that map information can be combined with other forms of data—about people, rateable values, geological conditions, and so on. Cheap computer memory makes such information systems possible, and management now seems willing to pump large amounts of money into their development. Not only is the cash suddenly available for map digitising, but there is strong pressure to get on with it.

Local authorities, for example, are being pushed to build data banks that combine information about people with financial and property data. Most are starting with land and property data, because it is in a relatively convenient form and is non-controversial; most have experimented with digitising. But Dr Alan Mitson of the Greater London Council said that a major deterrent to digitising the GLC's land-use information was that it was recorded on 7000 map sheets, many out of date.

Geologists were among the first to see the potential of digitising. A typical geological map is laboriously drawn by a draughtsman from 30 or more geologists' field sheets, separate bore hole data, and miscellaneous additions and corrections. The computer can be programmed to combine all the data and changes to produce a map.

Dr Mike Henson of the Institute of Geological Sciences described one trial in which 35 field sheets were digitised and combined with extra data. A map was produced in seven months which would have taken seven years using conventional methods, at about the same cost, he said. Geochemists have the opposite problem—too much data. They typically measure 18 or more different elements in a network of streams, and then want just a few listed on a particular map. Once data is in the computer, it is easy for the

geochemist to select those to be included on his map.

At present, digitising is a purely manual process. A map is placed on a digitising table to which is attached a cursor which can be moved over the lines to be digitised. Its movements are recorded on tape—either periodically by pressing a button or by a device which records its location every 0.1 sec. The problem is that the operator must follow the lines on the map very carefully and precisely. Thus the job cannot be done, for example, by people who normally do keypunching. But the job is so boring that it is difficult to keep staff of the calibre required. Therefore, researchers are looking for devices that require less well-trained operators.

High-speed digitising

Professor Ray Boyle and Dr Les Thorpe, of ECU, both described ways of increasing the speed and accuracy of digitising. One way is to attach a computer, which will at least take operator input data such as "start" or "end of line" and check it for consistency. Another is to display the data on a visual display unit which permits the operator to correct errors.

A more radical approach was put

forward by Dr Graham Street of Laser Scan Ltd. It is based on Sweepnik, a machine which uses a laser and was built for measuring bubble chamber tracks for high energy physicists. A map is projected on a large screen and the operator moves a pointer to a beginning point. Sweepnik assumes control and follows the track. The main problem occurs at junctions of lines. In high energy physics, it is possible to programme the system to select the line of interest, for example by picking a particular solution to an energy equation, and continue moving. This is much harder with a map, so that an operator must be present to at least make a choice of which line is to be followed next.

Dr Terry Lang of Liverpool University noted that automatic methods have been "just around the corner" for a number of years. But the shortage both of draughtsmen and of staff who will do manual digitising make it necessary to design systems specifically around the staff available, which in turn will require significantly more automation. For the next few years, however, it seems likely that there will be a sharp increase in digitising based only on manual systems.

Paul O'Grady



Beryl Bartley of the Experimental Cartography Unit at the Royal College of Art in London, uses a D-Mac digitiser, which is connected to a Digital FDP-11 computer. The pointer is used to follow map lines. Additional data is input from the pushbuttons—an ECU device known as the "hedge hog". For a geological map, such additional data might be clay on one side of the line and chalk on the other; for a local authority map it might be an address code

Energy file

Michael Kenward

This is the first week of a new regular section of *New Scientist*, designed to brief readers on the current boom in activity related to energy. Covering significant topical events, reports, and decisions. Energy file will concentrate on research and development, but will step outside this brief whenever it is appropriate to do so

Coal

Research boost

The return to favour of coal as a fuel, particularly in the United States and to a lesser extent in Britain, will have an impact beyond the mining industry. Research and development will also see a massive boost in effort and funds. The US Federal R & D budget for the 1975 financial year includes an increase in money for coal R & D from \$164.4 million to \$415.5 million (an increase from \$85.1 million in FY 1973).

Britain's National Coal Board (NCB) is also seeking more money for R & D, although on a more restrained scale. The NCB wants the government to cough up £40 million for coal R & D over the next five years. This claim on central government funds represents a departure from previous practice, whereby the NCB has paid for its own R & D. However, the NCB feels that its R & D proposals cover work that is outside its current activities. Therefore, says the NCB, it is unfair to bump up the price of coal to pay for R & D that may be of little benefit to existing customers.

The £40 million would be spent on a series of projects. It would involve building pilot scale plant for the following processes:

- a fluidised combustion unit for 20 MW, to improve electricity generation efficiently using coal;
- a gasification plant designed to produce synthesis gas from coal as a basis for hydrogen manufacture, substitute natural gas, or methanol;
- pilot pyrolysis units for producing

gas and oil simultaneously from coal; — liquefaction plants using liquid and gaseous solvents to make coal extracts and hydrogenated liquids; — a gasification plant to make low Btu fuel gas from coke; — production and testing of special metallurgical fuels.

The £40 million R & D programme would include feasibility studies on integrating these processes into a "coal-plex", described by NCB chairman Derek Ezra as "an integrated 'energy factory' with coal as the basic raw material and—with the utmost economy and full regard to environmental and conservation considerations—providing a flow of by-products, including oil, gas, electricity, steam, and chemicals".

The way in which this work might be funded is undecided. The R & D plans are before the Department of Energy, and will be considered in the talks on the future of the coal industry between the NCB, D. Energy, and the mining unions. One thing that does seem sure is that the US will be spending money on coal R & D in Britain. Next month Derek Ezra is due to sign an agreement on co-operation in coal R & D between the US and the NCB; and last month British Gas announced that the US is paying for a \$10 million R & D programme to be carried out at the Westfield works of Scottish Gas, in Fife. This establishment takes coal as its feedstock and produces town gas by the Lurgi process. North Sea gas will soon make this plant redundant; it will then become an R & D test bed.

Coal research in Britain should also benefit from the arrival of British Petroleum in the coal business. BP ex-

pects to become heavily involved in coal research. It is already a partner, with the NCB and the National Research Development Corporation, in Combustion Systems Limited (CSL)—a company set up to exploit fluidised combustion. BP went into CSL because fluidised combustion has oil burning potential, but its major impact will be on the coal industry. Fluidised combustion systems can burn high-sulphur coal without belching sulphur dioxide fumes into the air—the sulphur is retained in the ash.

CSL has not been the roaring success that was hoped for, partly because NRDC has been reluctant to invest money in the venture, but this experience has not soured BP of co-operative research ventures. The company is now looking into the possibility of teaming up with others, perhaps the NCB, on some research projects. It is too early for BP to know just what line of R & D it will pursue—last week the company held a meeting to help formulate its coal R & D programme—but BP is keen on building on the expertise of those more familiar with coal science and technology. The NCB is also sympathetic towards cooperative R & D ventures, and while it is not free to pursue coal mining abroad it can provide technical support to companies that do operate outside the UK.

Buildings

Skyscraper radiator

"Over the past two decades our cities have spawned hundreds of highly glazed boxes. Whilst some are undeniably attractive and well designed, others are at best repulsive. But irrespective of their aesthetic value to our society, they are an indication of extravagance, as witnessed initially, by the financial investment, in expensive and under utilised heating and cooling services, then by their subsequent demands on our fuel and energy resources, which result in exorbitant operating costs." Electricity Council man Derrick Braham put this viewpoint to a meeting on Energy efficiency and the internal environment, held by the Electricity Council last month.

Braham is surprised by the lack of information in the management of large buildings. The only energy accounting undertaken in many buildings is a quick look at the gas, oil, or electricity bills when they come in. A better approach would be to fit some kilowatt-hour meters, for example, in the various electricity circuits in a building. "A comprehensive energy monitoring installation would not need to be as sophisticated or as expensive as some of the temperature/pressure monitoring systems seen in modern offices. But the benefit of the energy consumption data would permit the system to be consistently efficient and the manager more effective."



Town gas is made from coal at the Westfield plant of Scottish Gas

Space

Hot support for the shuttle

The National Aeronautics and Space Administration (NASA) in the United States has not given up the idea of disposing of the growing pile of radioactive waste from nuclear power stations by sending it into space. A recent report tells us that, according to an exploratory study, "space disposal of the long-lived radioactive actinides from nuclear waste appears feasible from the viewpoint of both economy and safety. The transportation costs for ejecting the actinides out of the solar system, for example, would represent less than 5 per cent increase in the consumer bill for electric power generated by nuclear powerplants."

The growth of nuclear power could be such that if the US wanted to dispose of all of its radioactive wastes by sending it into space aboard space shuttle launches, then after 1990 more than one launch a day would be necessary. "This launch frequency is not considered practical at this time," says the NASA report. But if only the actinides—the more troublesome and long-lived of the nuclear waste products—are disposed of in this way, "required launch rates vary from less than 10 to 350 per year through the year 2010, depending on the fission product composition of the actinides and the destination." (The report looks at three possible destinations; Earth orbit, solar orbit, and into the Sun.)

Safety is, of course, going to cause some controversy if ever this notion catches on. The team studying this project looked at the possible accidents that might befall a space disposal system. "In all cases the response of the waste package to the proposed accidents indicates that the release of radioactive waste would be prevented by the various protection shells designed into the total waste package." "However," warns the report, "much additional development and testing are required to confirm the design concept."

Parliament

Choice witness

Secretary of State for Energy, Eric Varley's avowed intention to "co-operate as much as I can with the Select Committee" will soon be put to the test. Mr Varley is to be the "guest" of the House of Commons Select Committee on Science and Technology on 15 May when he is due to give evidence before the energy resources sub-committee.

Varley will be watched particularly closely by the committee, which welcomed his statement in an interview with *New Scientist* that he is keen to help the committee. The MPs will be looking for signs that the civil servants have not persuaded their boss that he



Trust the Ruskies to think up a sneaky trick like that

should follow his predecessors and "maintain a low profile" in his performances before the inquisitorial probing of the members of parliament, many of whom have far more experience in dealing with ministers than Eric Varley has in handling embarrassing questions.

Other potential witnesses before the energy resources sub-committee will also want to watch the performance of the Secretary of State: he will set the tone for this new set of hearings. The committee's plans to take a broad look at Britain's energy situation were torpedoed in the last session when the perennial issue of nuclear reactor policy came up again. And this topic could rear its head when Eric Varley talks to the committee. His appearance will come after the reactor issue has been debated in the House of Commons, but probably before the Secretary of State has made public his decision on the future of Britain's reactor systems.

Solar

Ball of fire

"People are coming up with information that was found out twenty, forty, or even a hundred years ago." This negative view was universally accepted by the delegates attending the first working session of the UK section of ISES (the International Solar Energy Society); but it was also clear that they expect the situation to change dramatically in future.

Margaret Shain, who made this point, is in a team of students at the Polytechnic of Central London which has prepared an impressive survey of solar heating installations in the UK. According to this team; "The accounts of work . . . covered in this paper may overlap in places, and we found this was probably due to lack of communication between groups and individuals, which necessitates the duplicating of basic experiments."

Such communication has been difficult in the past. Before the formation of ISES UK last year, there was no way in which the people involved, many of whom are dedicated amateurs spending their own money and working on their own premises, could meet to pool their experiences.

Now, after 10 years of "polite interest", several large commercial firms are showing signs that they want to become actively involved in solar energy—A. Pulford of Pilkington Brothers said that his company is planning to carry out some market research. And ISES is fuelling the growing interest. It has already had talks with the Secretary of State for Energy; and it is now hoping to try to convince the energy resources sub-committee of the House of Commons Select Committee on Science and Technology that solar energy is not a silly idea in cloudy Britain.



When all's said and done electricity remains a most efficient and flexible means of harnessing the world's resources for industry's needs.

It is now very clear that supplies of cheap energy and abundant mineral resources can no longer be taken for granted.

Industry must now take a new look at energy and raw material costs, fuel availability, and the relative efficiency offered by alternative energy sources.

Higher efficiency must be the aim. Traditional processes that are wasteful of heat and fuel must be replaced.

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waste heat, fuel, and labour, and also permitting more effective conversion and utilisation of precious raw materials.

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Forum

Westminster scene

An MP's story



When I read books by academics about politics, I sometimes wonder if I live and work in the same world as they describe. They tend to dwell on great issues, about which we are all supposed to have thought deeply, and weighed our actions. Alas, the reality is somewhat different. This is why I commend to anyone who is interested in what an MP's life is like, a book by John Grant, MP for Islington. Its title is "Member of Parliament" (Michael Joseph £3 net). Grant is now a minister for the Civil Service Department, and was Opposition spokesman on broadcasting and the press. The book consists of his day-to-day diary, giving a truthful account of his year, 1972-73. The fact that he is careful about comments on his colleagues, with whom he can expect to live and work for the next quarter of a century, does not detract from his work, though it makes it rather different from Don Riegl's diary on the life of a rebel Congressman, which appeared in Britain some 18 months ago. What Grant does demonstrate is the inter-action between MPs and outside bodies—for example, the Civil and Public Services Association, led by Bill Kendall. In days when displays of militancy by what Grant calls "traditionally peaceful government employees" are becoming less rare and less untypical, it is important to have a two-way dialogue between politicians and those organisations, which have tended hitherto to have done their business with governments in somewhat polite surroundings. Grant's references to his contacts, with the world outside Westminster, originating often from the days when he was chief industrial correspondent of the Daily Express, make this book a "must" for those who feel that the mysterious world of politics and government is a sphere about which they ought to know more, but in which they are currently bewildered. In particular, anyone lobbying or approaching MPs for a cause would do well to read "Member of Parliament", if they wish to make their effort productive. From Grant, one can get a fairly clear notion of what an MP can do, and equally relevantly, what he can't do, and of what it is reasonable to ask him, and what is impossible.

★ ★ ★

Amid the present anxieties of British Leyland, it is an opportune moment to hear of the government's attitude to the sodium-sulphur battery, by which leading members of Leyland set some store, when they had their annual meeting with MPs in January, at Lord Stokes' invitation. Frank Beswick, Minister of State in the Department of Industry tells me that if it can be successfully developed, the sodium-

sulphur battery could provide a useful stimulus, not only to the wider use of electric road vehicles, but also to applications in the railway locomotive field and in providing stationary power supplies. Beswick adds that its development does pose severe problems, "and it is far from certain that these can be solved satisfactorily." The DTI supported work for the past two years at Harwell on the sodium-sulphur battery system, and related engineering studies. Because of the relevance of the subject, the Department is exploring a number of methods by which energy could be stored effectively and safely. I suspect that Lord Beswick's cautious optimism strikes the right note. However, several friends from different sectors of the motor industry tell me independently that if the sodium-sulphur cell is to be a commercial possibility, research must on no account be allowed to drool on indefinitely. Part of the difficulty that has arisen between the motor industry and university research which could have been potentially helpful to the motor industry has been the requirement of the manufacturers for yes/no type answers, in a given time-span, of the kind which academic researchers either do or can not give, or are unused to giving. If the academic world is really to serve the motor industry, and implement a number of virtuous platitudes which we have heard recently, then the researchers must acclimatise themselves to crash research programmes, giving guidance for a definite course of action.

★ ★ ★

Following a paper I gave to the British Association at Canterbury, Kenneth Mellanby, chairman of my meeting, sent me a copy of his Minerva article, "The Disorganisation of Scientific Research" in which he attacked the increase in staffing of "customer" government departments, which is currently a source of controversy in the pay dispute of government scientists. Gerry Fowler, Minister of State at Education, points out to me that, as a result of the Rothschild Report, successive governments have recognised the need to strengthen scientific administration in departments, by setting up chief scientist teams and requirements boards. Most of this effort has been directed towards improving departments' own research and development programmes, with only a small proportion of administrative time spent on commissioning research from Research Councils. Fowler refers to a small but closely controlled increase in Research Council headquarters staff as a result of the introduction of the customer-contractor principle. It is not envisaged that the overall increase in HQ staff will be disproportionate to the growth in manpower as a whole. "Indeed", says Fowler, "with the establishment of the new administrative patterns this proportion may well decline." The trouble is that with a jittery, election-orientated Parliament, not enough attention is given to such matters which are important, but do not influence votes. Tom Dolbey MP

New York view

Environment victory

One of the noticeable differences in the practice of science and technology between Britain and the United States concerns the use of the courtroom. In the US, pressure groups and government agencies involved with science-based areas seem just as eager as political organisations to undertake litigation to settle problems that would be dealt with by committee or by fiat in Britain. Two recent court cases in widely different areas—one environmental, the other medical—illustrate just how far-reaching the effect of legal action on science and technology can be.

The environmental matter has been simmering a long while, but only recently came to the boil. At issue is the discharge of industrial wastes into Lake Superior, the great lake surrounded by the states of Minnesota, Wisconsin and Michigan and the Canadian province of Ontario that is regarded as perhaps the cleanest large body of water in the world. The area of interest is the extreme west of the lake on the Minnesota shore, where the Reserve Mining Company has a large iron ore plant that employs 3100 people and produces about 15 per cent of the US supply of the ore. The plant, in Silver Bay, Minnesota, extracts the ore from taconite, a hard rock mined some 50 miles to the west. After extracting the magnetic iron ore, the company dumps the "tailings" into the lake, at a rate of about 67 000 tons per day.

The first major scare about the dumping came last June, when scientists from the Environmental Protection Agency discovered extremely high quantities of asbestos fibres in the drinking water of Duluth, a city 60 miles along the lake shore from Silver Bay that draws its water from Lake Superior. The fibres were similar in appearance to those known to be associated with the outbreak of cancer among asbestos miners: of course, the 100 000 citizens of Duluth were drinking water containing the particles rather than inhaling air in which they were suspended, but the finding certainly created a stir in the city, driving sales of bottled water up to new highs (New Scientist, vol 59, p 340). The EPA announced its belief that the finding represented no immediate danger to the populace, but it did recommend that parents find an alternative to tap water for their infants. In addition, the agency, joined by the States of Minnesota and Wisconsin and several environmental groups, went into federal court, charging Reserve Mining with polluting the lake and the air with discharges from its plant.

To date, the trial has lasted nearly 10 months, and much of that time has been taken up with efforts by the prosecution to encourage Reserve Mining, which is owned by ARNO and Republic

Steel, to develop some feasible method of getting rid of the taconite tailings on land. Countering that suggestion, Reserve Mining's lawyers have argued that the government and the state of Minnesota should help to pay for any such conversion whose cost, they reckon, would run to hundreds of millions of dollars.

Two weeks ago (20 April be precise) the case reached a sudden climax. Noting that the taconite tailings create "a serious health hazard to the people exposed to them" in Duluth and other lakeside towns, federal judge Miles Lord gave Reserve Mining just seven hours to close down operations at Silver Bay, and ordered the company to remain closed until it could obey federal and state anti-pollution standards.

That decision involved the halocing act that is implicit in almost every environmental problem—between workers' jobs on one hand, and the pristine nature of the environment on the other. In announcing his decision, Judge Lord took note of the unemployment that would result from it, but commented that "The court must consider the people downstream from the discharge. Under no circumstances will the court allow the people of Duluth to be continuously and indefinitely exposed to a known human carcinogen in order that the people in Silver Bay can continue working at their jobs." The health hazard itself, the judge notes, "is impossible to quantify at this time"; however, he voiced the concern of a number of researchers in the field that any carcinogenic effect of the asbestos fibres would not show up for 15 years or more after the initial exposure. As to the Reserve Mining suggestion that the state and federal government provide monetary aid for a change of discharge locality from lake to land, Judge Lord termed it "preposterous".

The decision surprised just about everyone involved in the case. Environmentalists hailed it as a major victory that might create a strong precedent, while Reserve Mining workers were stunned. "A lot of us figured that there would have to be change in disposal methods", complained one member of the work-force. "But we didn't think that the plant would be completely shut down!"

As it happened, the shut-down lasted only two days. Then an appeals panel of three judges granted Reserve Mining permission to go back into action, at least until 15 May. On that day, the panel will hear a motion to suspend the shut-down until an appeal of the entire case—which is continuing as Judge Lord considers ruling over possible penalties and compensation—can be heard. But clearly, the environmental forces have won at least a temporary victory that will reverberate in boardrooms throughout the US.

The other recent court case concerns a pressure group that, in some parts of the

country, is as powerful as the environmentalists: this is the anti-abortion movement, which is desperately fighting last year's Supreme Court ruling that state laws banning abortion are generally unconstitutional. Three weeks ago in Boston—a largely Roman Catholic city noted for its concentration of excellent medical schools and teaching hospitals—so obstetrician was charged with manslaughter in connection with an abortion he performed involving a 24-week-old foetus: in addition four members of his research team were indicted under a grave robbery law dating back to 1814 for performing experiments on the tissues of dead, aborted foetuses, in a study designed to determine the effects of different antibiotics in preventing infections in unborn foetuses. Once the indictments were announced—by the office of a district attorney who is running for reelection this year—the city's medical community reacted with a wave of indignation. As a result the board that oversees Boston city hospital, where the research was carried out, reinstated the doctors, who had been suspended without pay: the board noted that it found nothing in the records to indicate that the abortion was illegal, and that experiments were not performed on living tissue. Nevertheless, the case has caused apprehension among researchers who routinely use foetal tissue, and already show some signs of forcing a cut-back in such research.

Peter Gwynne

Pig-ignorant

More about knowledge

Last time, this column examined the idea that science's main effect is to make us all more ignorant every day. Piece by piece science is true enough, perhaps, but the details are aggregated into a great bedrock of unassailable human knowledge, a tide of assumptions that laps ever higher up the vessel of the Universe. You might have to admit that you, personally, could not verify, by doing the experiments, more than a fraction of this knowledge, yet you accept it as solid. Why? Because it is verified by an elaborate system of rival researchers duplicating, in the hope of discrediting, each other's results, commenting, criticising, suggesting, by a custom of submitting papers to eminent referees, by a system of communication among experts which selects the true and rejects the false. But, when all is said and done, this is a political process, not a scientific one. I personally have no evidence at all for the existence of the electron or the syphilis spirochete, or botulin toxin, or radioactive fallout or lung cancer due to smoking (I may be right about this one) or homicidal psychosis, yet I adapt my life and my children's lives to account for these and thousands of other things that have been discovered and vouched for by the scientific process. Yet how do I know about the electron? I haven't got, and couldn't work the necessary apparatus to demonstrate it, and

even if I had, I lack the professional indoctrination to ignore "spurious" results. Instead I ask the Wykeham Professor of Physics in the University of Oxford or, for the sake of completeness and euphony, the Plumian Professor of Astronomy and Experimental Philosophy in the University of Cambridge, or their deputies, assigors, interpreters, apologists, students or cleaning ladies. I do not, on the other hand, pay any attention to the gentleman with straw in his hair who assures me that electrons are the minutest green apples, or his friend with the saintly expression and outstretched palm who asserts they are the souls of the departed in light.

My evidence about this basic building block of the physical world, a truth which is supposed to be completely independent of time, place or person, is actually based entirely on political or social evidence. If the Plumian Professor assured me that electrons were the tiniest possible fruit, while the fellow with the agricultural coiffure said no, they were wavicles of a nature which one could not readily comprehend save through the veil of mathematics, I would again believe the first rather than the second.

My only way of distinguishing between these rival theories is to ask which of the protagonists is a professor and which is not. (Though the "wrong" one might well be a professor in some other discipline.) Experiments about electrons become experiments about professors. How do you tell? Do you ask the vice-chancellor? Who's he? Ask the Congregation? Who are they? You look at the University's charter as amended by Acts of Parliament. What's Parliament? You ask the electorate. Thirty million voters can't be wrong about the electron.

Not that they are going to give you any trouble about that or indeed any other atomic particles. But had we been alive and well in Germany in 1932, we would have been well advised to consult the electorate before making any rash statements about electrons, because the doctrines of the Jew Einstein were naturally unacceptable to any right-minded Aryan physicist. Any e=mc² rubbish ended up in a noose of piano wire. Stalinist genetics is another well-known scientific freak, and one imagines that these things are isolated and identifiable. But even so, the effects linger on. Jungian psychoanalysis got a boost from the Nazis' ban on the Jew Freud and all his works. These aberrations are identifiable when they are thrown up by some outlandish foreign political system. They are easy to detect and cauterise. But are they always? They are easy to detect when they run counter to a stronger and better established doctrine in the land of the free. But what if there isn't any other doctrine, because no one has thought of it yet, or those that have thought of it are not acceptable?

For instance, the question of the negro IQ causes vexation in scientific circles. But apart from the deliberate falsification of results, the whole question is fundamentally a political one: an IQ predicts, very roughly, how well a person will do in a particular social situation—usually a white anglo-saxon middle class career. Negroes do not even start in this race; if



they did they would do badly. If the IQ test is any good, it must give them lower marks than whites—and so it does. An IQ test normalised to predict success as a hush-hunter using bows and arrows would make most white men look pretty stupid.

Much of social science is in fact political dogma shifted into another arena where much of it, after the ritual of research and report has been gone through, is dutifully accepted by everyone as "true". For instance, results like these: "In a free economy prices will move so that supply equals demand"; or "Poverty is highly correlated with personality maladjustments", disguise political relationships and set out the ground rules for the social and economic system. In effect the first "result" says: "The price you can charge for a good depends on how effectively you advertise it"; the second, translated into good round English: "The poor are a feckless, hopeless lot and deserve to stay that way". And, of course, they must stay that way, for they serve as a living example to others in our industrial system of what happens if you don't turn up in the morning when the hooter sounds.

The social sciences would be far less tiresome if their practitioners would take the fluff out of their mouths and say what they are really doing in a full, frank and manly way. But if they did that there would be ructions. The veil of science has been pulled over their duties, which are essentially those of garrison troops in 19th century industrial cities—to prevent public outcry and discussion. Indeed, by now, very few of them know what they're actually doing.



LURTH

But one must not think that the measure sciences are in much better case. Certainly their results are less tendentious, less to do with political advantage, more based on a reproducible physical reality, but they depend nonetheless on the original direction of research. Why did the electron seem a good illustration earlier in this piece? Because electric power is the fundamental of social control based on a mass production industry, because electronic communications are the foundation of modern government. We know a great deal about it and for good reason. It was a good understanding of the social possibilities of the electron that defeated the 1926 General Strike, that carried Hitler to power, and eventually into a ditch in the Reich Chancellery garden. This is not an atomy that any modern political machine is going to ignore.

When an objective history of science is written it will prove startling how much its impartial truths followed the paths of commerce and political power. There have been many since Newton picking up pebbles by the sea shore, but the path they walked along led to Poldhu, Bikini and San Clemente. Who knows what they would have found if they had walked another way?

Peter Laurie

Venture

Game business

"With only £75 000, they folded after three issues." So Graeme Levine describes rather scathingly the fortunes of a recent magazine, launched in the accepted way. He started his own monthly, Games and Puzzles, with a £10 overdraft. It now sells nearly 20 000 copies after just two years. Is it profitable? "I've lived. So it must be at this stage. But for a very long time it wasn't. Really it was just my own confidence and the enthusiasm of our readers."

Levine, a South African, took three business qualifications at the University of Capetown, which also included subjects such as market research, advertising, and psychology. Then he had six years of commercial experience, mainly in marketing and finance. He was a games fanatic all the time. He would take a note of every ball bowled in every first-class cricket match he could go to. He still has records of several hundred Scrabble games he played. In 1971 he came to Britain, resolved to start his own company. "One knew there was a gap in the market for a games magazine directed at intelligent readers, but I didn't even know what type-setters were."

He did not have the money to put together a dummy issue, though it is normally considered essential. But with a mock-up of a front cover he managed to persuade newsgroups, such as W. H. Smith, to carry the magazine.

After 10 months' preparation the first issue was printed. An unimpressive pink and red cover, 32 pages, rather limp; articles about wargaming, racing demon, Monopoly, Go, and the various types of table football; seven pages of puzzles, a feedback form asking for readers' views about every article; several competitions, including one in which readers were required to suggest the best way of improving sales.

Early issues sold poorly. Circulation climbed painfully over the next year to about 12 000. Then, in February 1973, Levine switched to Punch as distributors. Since then sales have risen more than 50 per cent. There are now beautiful multicolour covers, and issues with 44 pages. Levine still runs with the lowest possible overheads. He has a barely furnished front office behind an employment agency at 11 Tottenham Court Road, London. It leads to a large room with blackened, peeling wall, a crumpled carpet, a mountain of games in one corner, orderly boxes full of "only the better games" in another. He feels obliged to distribute games which the magazine recommends to save his readers from frustration. "Most shops do not care what games they sell. They simply listen to what the sales reps say."

How much does the ample feedback from readers affect Levine's editorial policy. "We do listen to what people say. We don't get things out of proportion for one reader's sake. But we do rectify mistakes very readily. We haven't the money for market research, you see. We have lengthened the puzzles section. We put

more emphasis on historical games. We now take longer and more authoritative articles. There is more emphasis on educational games." Recently the magazine has started to review simulations too. There is a very esoteric mediaeval one called Hyboria, for example. Each player has a role such as a merchant or general and pits his wits against the other players through a postal centre. Hyboria has its own newspaper, history books, traditions, magic. Shelter provides a simulation called Tenement. Each player takes the role of an oppressed tenant, a hoot-faced bureaucrat, or the capitalist landlord. I have seen the pensioner commit suicide, the unmarried mother make it with the landlord, and the housing department refuse to interview the unemployed van driver.

Levine himself is too busy to try the simulations, though he plays all the games. He sells a successful cricket game which he developed, and manufacturers have taken up several other games of his, including Speculate, which he invented after experience in the stock market. "I decided I would like to convey the emotions of the Stock Exchange. The game is often frustrating or even tedious. It puts a lot of pressure on the players nearly all the time. It has been a great success." His social life? Although he has a family, it has been drastically affected. "There is no point in doing it in a half haked fashion."

Does Levine see any future in the overtly emotional games like Hang-up, Lihido, or even charades. "They are generally very weak. Most of them are a psychological concept packaged in a box. If this box falls into the wrong hands it could be very dangerous. Lihido and things are harmless. You could take any board game and say if you land on certain squares you have got to take your clothes off, and call it a sex game. In fact all games do expose emotions. But usually the situation is controlled. With one that we have got which is basically a Rohnsbach test, not well controlled, you could run into trouble."

What about games in which people have to help one another, rather than compete? Levine sees no evidence of games to teach cooperation. "I believe very strongly in free enterprise and competitiveness anyway. Though it would be quite an achievement if one could introduce non-competitive games which really worked."

Tim Eiloart

Perspective

What is science journalism for?

There is always something slightly unreal about groups of journalists sitting around talking or writing about themselves. The journalist's job, basically, is to talk and write about other people. When he turns inwards, he has taken the first step towards that chimerical infinity that is exemplified for me by a childhood memory of a brand of honey, the label

of which showed a bear eating a jar of honey, on which there was a label which showed a bear eating a jar of honey, on which . . . and so on, until even the finest print could no longer continue the illusion. Nevertheless, last week, in Salzburg, about 50 science journalists from nine European countries gathered together, under the auspices of the European Union of Associations of Science Journalists (a loose federation of national bodies, including the Association of British Science Writers) to discuss "Science journalism and its role in the society of today". At the end of the meeting, a pompously titled "Salzburg declaration" was issued which, in effect, said that the gathered assembly was in favour of good, and against sin, and that science journalism was good, so there should be more of it.

It was, in the end, a harmless enough declaration and, in most places, will no doubt be ignored. However, it did not start that way. Preliminary documents for the meeting, most of which were prepared by the large German-speaking contingent, had called upon governments to do a variety of things, ranging from the creation of ministries of science and the development of bigger science policy programmes to the funding of university courses in science journalism. Basically, as became apparent early on, there is such a gulf between science journalism in different European countries, that only under the shade of the broadest

platitudes could everyone find common ground. Of the nine countries involved, for example, it appeared that only in Britain and Switzerland is there a trend for specialist journalism to become a graduate profession, so that one can foresee a time when nearly all science journalists will have taken degrees in science. This contrasts with the approach in Austria, for example, where there appears to be a trend towards graduates having degrees in journalism, as happens in the US. As journalism is basically a craft, it is difficult to see how one creates a degree course for it.

There was a strong feeling among many of the delegates at the conference that science journalism is a Cinderella subject, badly treated by the Ugly Editors. When I suggested, at one point, that it was strange no-one had mentioned that science journalism ought to be entertaining, and perhaps it got too little space because those who practised it took themselves too seriously, there were a number of shocked looks. But perhaps the idea of entertainment translates badly into German; certainly, an enormous amount of time was spent in clarifying what things meant in three languages. During the plenary sessions of the conference, where there were simultaneous translations, this created a new experience in boredom: bearing identical simultaneous translations of points made by German- and French-speaking delegates, which they clearly

felt were fundamentally different. Of course, journalists are supposed to be attuned to the nuances of their own language; hence, much time was devoted to the verbal equivalent of fine print.

A number of the continental delegates see the saving of science journalism (and, ultimately, society, the crises of which can be alleviated by science journalism—they believe) in the inclusion of special pages dealing with science in the newspapers. My own view is that, if science is confined to a special page, it makes it easier to ignore. Science journalism should be integrated with other journalism, just as science should be integrated with other societal concerns, and not treated as something special and different.

What, then, is science journalism for? I don't really know; but, after three days of Salzburg drizzle, I still think it is something you do rather than talk about.

Martin Sherwood

A grounding's notebook

Brains and belly-pounding

I see that the boldly pioneering South African medical profession has been at it again. It is not only the good Professor Christian Barnard who writes medical history on those sacred tablets to be found around Table Mountain. For something like a couple of decades now, doctors in and about the Great Karroo have been striving to discover how to get the ex-colony's womenfolk to give birth to super-babes.

Older readers will recall the stir caused by Professor O. S. Heynes who, in 1955, invented decompression babies. Well, he didn't actually invent the babies. The infants in question continued to be manufactured by age-long traditional methods, and according to specifications first patented way back in Eden. What the good Prof Heynes did invent was a kind of half-body space suit to be fitted around the lower end of pregnant ladies, and within which the air pressure could be raised and lowered. It was a sort of iron lung for the belly. The claim was that by applying what amounted to artificial respiration to the womb and its precious load, it was possible to increase the blood flow through the placenta greatly. Therefore, argued the inventive Professor Heynes, the developing infant would enjoy an extra ration of oxygen, and a super helping of all the other goodies to be had out of mum's blood, and this benefit would allow its tiny mind to develop at an unprecedented rate, so that the child would finally be delivered into the world possessed of the IQ of a genius.

And that wasn't all, by any means. The disciples of Professor Heynes claimed that, apart from producing super-intelligent babies, the bottom-end decompression suit also encouraged rapid and painless labour, prevented or cured

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toxemia of pregnancy, relieved backache in men and women, lowered high blood pressure, and generally provided the answer to a mother's and an obstetrician's prayer.

Needless to say, miraculous effects were observed by doting parents and credulous physicians following the use of Heynes' pneumatic pumpmeller. A book on the whole fangangle, recently published in the US (where some of the few remaining enthusiasts for the exercise are to be found) reports, for instance, the words of a mother, describing the accomplishments of her "decompression" daughter. "Yes," claims mum, "she's already saying things like 'You may go out. I won't be miserable!'"

As a doting parent myself of some considerable seniority and experience I know exactly how this kind of thing happens. You get your infant victim in a corner so that it can't escape, then you squat on your haunches facing the poor little blighter and start assaulting it with baby talk. "There's my little itty-witsy-oosy-kusky den! Dadsy-wadsy has to leave his little luvy-duvy for a liddle. Luvy-duvy won't be sadsy-wadsy will oo?" At this point the infant victim, nauseated beyond further forebearance by the pitiful display of parental idiocy, lets out a strangled cry of impatience and disgust. This causes the besotted dasy-wadsy to spring to his feet shouting "Did you hear that? Well, did you? He said 'All right, daddy!' That's what he said. Didn't you hear him say it?" Then dasy-wadsy dashes off to the pub where the tale is repeated over and over again, with little Johnny's remarkable vocabulary gaining in size and polish with each passing hour until closing time. And so the fable of the articulate suckling is born, and enters the folklore of the place.

Unfortunately the miracles achieved by the use of Heynes' belly pounder now seem all to have taken place solely in the eyes of the beholders, and there are no 19-year-old latterday Miltons and Newtons pouring out ecstasies or reordering the universe in witness of the wonders done to them while in the womb. The British manufacturers of the Heynes machine gave up making the things or hiring them out in 1971. But South African physicians don't give up that easily, and now I read in the International Herald Tribune that "A team of South African doctors has injected an expectant mother with experimental hormones which they say could double the intelligence quotient of newborn babies and revolutionise the science of obstetrics". The hormone they are using is human chorionic gonadotrophin, and according to Dr Peter Baillie of the Groote Schuur Hospital, it "helps placenta efficiency in the last four weeks of pregnancy when the baby's brain cells develop".

The latest news from the Cape caused me to wonder just why it is that doctors in SA are so convinced of the inefficiency of the placenta as God made it, and are so dedicated to the proposition that there's got to be a way of breeding smarter babies. Then, yesterday, I think I found the answer. I read an account of the South African polls at

which the Prime Minister, Mr Vorster, having claimed that the world envied SA for (inter alia) "ber robust idealism", then concluded a public slanging match with his United Party opponent with this memorable and devastating coup de grace: "Go and play marbles, young man."

I can quite see that the country may desperately feel the need of some means for doubling the national IQ.

Donald Gould

Tantalizer

No 345 Compleat idiots

"Here's a small puzzle for you," Peter Puffer told the regulars in the Compleat Idiot last night. "Six anglers had a day's fishing. One caught 80 fish, another poor lad caught none, and the rest caught various numbers between. Arthur Anchovy caught half as many as Dace and Flounder together. Bertie Bass caught half as many as Anchovy and Flounder together. Charlie Crab caught half as many as Dace and Elver together. Freddie Flounder caught half as many as Crab and Elver together. How many did each catch?"

There was a long ruminative silence. "That's insoluble," remarked the barman at last.

"Quite right," admitted Peter Puffer

cheerily, "I forgot to say that they caught in all more fish than there are Latvian logicians."

"We don't know how many Latvian logicians there are," the barman protested.

"But I do and I assure you that, if you did, you could solve the problem."

How many did each catch?

Martin Hollis

Solution to Tantalizer No 344 Elementary!

Doyle: †

Given the data, the only coherent sets of final scores are 3, 1½, 1, ½ and 2½, 2, 1, ½. The former can be squared with 1 or 2 draws, the latter with 1 or 2 or 3. (We know there was at least one draw.) So Mycroft must have had three draws in mind, if his puzzle had a unique solution. The score sheet must read as in the diagram. A vs B and C vs D (both draws) occurred in what must have been the 2nd round. So the 1st round was B vs C (draw involving M) and A vs D, which makes A=L. So B=N (won in last round). So C=M and D=O.

	A	B	C	D
A	—	½	1	1 = 2½
B	½	—	½	1 = 2
C	0	½	—	½ = 1
D	0	0	½	— = ½

Molecular Biology comes of age

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The enriching politics of South Africa's uranium

It seems to be the need for greater export earnings rather than any atomic weapons ambition that is driving South Africa to develop its own nuclear fuel industry. Piecing together the scientific jigsaw suggests that South Africa's "unique" enrichment process is probably either an ion-exchange or liquid extraction method, and not the West German jet-nozzle process that figured in press speculation last week

Mike Muller
is a freelance
journalist

From its military origins, the uranium enrichment business has inherited the habit of secrecy. And as the industry approaches the commercial take-off point, competitive pressures ensure that no information is released until parties concerned are quite ready. So the reports last week (*New Scientist*, vol 62, p 170) that the German STEAG group had signed a contract with South Africa to establish a uranium enrichment process in that country sounded authoritative. But were they?

On investigation, the origin of the reports could not be traced. South African officials claimed to know only what they read in the newspapers. But West German sources told a different and more puzzling story.

The West German scientific counsellor in London confirmed that an agreement had been signed between STEAG (Essener Steinkohlen Elektrizität, a subsidiary of Ruhr-Kohle) and the South Africans. But it was not an agreement to build an enrichment plant, he said. It was not even an agreement to exchange technical information. STEAG had merely agreed to look at the comparative costs of the jet-nozzle enrichment process which is being developed at the Karlsruhe Atomic Energy Research Institute and South Africa's own "unique" process, the nature of which has never been revealed.

The STEAG group has a contract with the Karlsruhe Institute to take the jet-nozzle process past pilot plant stage as a second-string to West Germany's main enrichment effort—the gas centrifuge partnership. And the Germans are anxious to emphasise that no "state technology" from Karlsruhe will be leaked to the South Africans via STEAG.

This, once again, raises the question of the nature of South Africa's mysterious enrichment process—for it is becoming obvious that it is a force to be reckoned with. And what is STEAG's role—that of collaborator or potential customer?

An excursion into the history of South Africa's nuclear effort gives some pointers. It also gives a revealing insight into the influence which national political policies exert on science and technology there. The South African nuclear story began in 1943—actually in the United States. A team of geologists reviewing literature in the course of a survey of uranium reserves for the Combined Development Agency, the raw materials arm of the Manhattan project, came across a reference to South Africa. In 1923, uranium had been reported in association with the gold bearing ores of the Witwatersrand reefs. Further investigations confirmed large re-

serves, as well as significant quantities in the tailings from gold extraction processes.

The agency acted in accordance with its mandate "to control to the fullest extent practicable the supply of Uranium and Thorium ores". The US Atomic Energy Commission had pinpointed South Africa as the most important post-war supplier of uranium. Under conditions of wartime secrecy, which continued into the 1950s, a programme was started to exploit the South African reserves. At the centre of the operation was the Government Metallurgical Laboratory (GML) in Johannesburg. It was, as one of its staff has written, "a peculiarly suitable instrument to collaborate in an international, urgent and secret research programme and to play a decidedly significant part in the evolution and rapid development of a large new industry."

Forefront of technology

Work at the GML resulted in a successful ion-exchange process which became the basis for uranium extraction. With British and American help, the South Africans found themselves at the forefront of uranium extraction technology, and when the production plants were set up the GML concentrated on examining the fundamental principles underlying the extraction process. The technical links forged with Britain and the US have been maintained up to the present.

The formation of the South African Atomic Energy Board in 1957 saw the GML become the home of the Extraction Metallurgy Division of the AEB. Research continued on the production of nuclear grade material. The industrial production of uranium tetrafluoride, hexafluoride and dioxide was investigated. Nuclear grade uranium metal fuel rods for a sub-critical reactor were fabricated. And uranium extraction was further improved with the introduction of a liquid-liquid process.

Meanwhile, the AEB was mapping out the broader aspects of South Africa's nuclear future. Although the country has vast reserves of coal, the prospect of nuclear generated electricity is attractive, particularly for the coastal areas of the South Western Cape and Natal, which are a long way from the coal fields. And investigations began at an early stage into the possibility of going nuclear.

One of the AEB's priorities was to establish a team of scientists and engineers who could assess the advantages of the various reactor types then being developed. "The choice had of necessity to be made against the back-

new scientist

Contract research review

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Contracting for innovation

Richard Cutting

is managing director of
Cambridge Consultants Ltd,
Bar Hill, Cambridge

Innovation has become a fashionable word, and its true meaning is consequently becoming rapidly obscured. In the business context, it now suggests a universal panacea—a soupçon of which will cure all ills and lead to runaway profits and success while one's competitors plough through the mire of conventionality. The reality, of course, is very different. But innovation and new developments are essential to the continuing prosperity of technically-based industries and the individual firms within them. The pace of technological advance continues to increase, product lives shorten, new products become practicable and the general awareness of the utility of technology spreads ever wider.

A contract research organisation is usually a limited company, which earns all its income from clients who sponsor development projects with it and whose employees are predominantly technical graduates or qualified technicians. The individual development projects may consist of anything from a theoretical technical study through to the design, development, test and production engineering of a complex new product. The

The contract research business has become a growth industry in its own right. It cannot, of course, supply innovative solutions to problems on demand, but it is uniquely structured to respond effectively to a great variety of development situations

common feature of all the development project situations is the contractual relationship between the client (the man with the problem or requirements), and the contractor (the contract R & D facility). The much-lauded "customer-contractor" relationship is at the heart of the contract R & D industry.

A contract implies money exchanged for value received—and herein lies the first key feature of the contract research business. No customer will willingly be parted from his money without first deciding a clear statement of his objective—that is, the value which he expects to receive. The formality of the relationship and the stimulation of interest provided by the actual spending of money with the contractor are both excellent spurs to the discipline of properly defining the objectives of the development situation. This phase is usually the first point of contact with the contract R & D company, and can in itself be a valuable clarifying exercise. Starting with some idea of the end objective, it is not difficult to select one or more companies with whom to discuss the requirements (see page 6). Most companies will respond

readily to a request to consider and discuss a potential client's technical requirements! This discussion can also be a useful opportunity for both parties to assess the compatibility of the requirement and contractor. All being well, the client will then request a formal statement of a proposed programme of work and associated quotation of cost. Thus far the client will not have incurred any costs with the contractor, except by prior agreement, although the costs of preparing the quotation are commonly included in the total price that is eventually quoted for the project.

Given one (or more) formal statements of a proposed work programme and associated costs, the prospective client is then in a very good position to consider the proposed development project in its entirety. Whether the proposed project is a technical feasibility study—after which further decisions will be necessary—or the development of a substantial working prototype, the consideration of a detailed proposed work programme by the client and the contractor invariably forms the essential foundations upon which the rest of the project proceeds.

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It follows that both parties should be resolute in clarifying any areas of uncertainty. In particular, if the client has any concerns about detailed work content, progress reporting intervals, payment structure, total time to complete an agreed end point of the job, then these questions should be brought into the limelight before proceeding with the contract.

The situation is analogous to someone programming a computer. The contractor has available a large number of resources, skills, techniques, personalities and many other degrees of freedom; and unless the client is careful to define how these should relate to his project, there is a definite probability that the end result will not be as he hoped or expected. This should, of course, form a normal part of the prelude to any development project, but where the client is spending money with the contractor he should accept that he can, and should, call the tune and not be diffident about ensuring that the details are indeed as he requires them. With hindsight, it is possible to identify development projects which were doomed to fail from the outset, because of a poorly defined working programme or contractual arrangement. This failure can occur even if the development project encounters no major technical snags. This essential requirement for clarification of the objectives and content of the development project before a contract can be agreed is one of the fundamentally important points about the contract R & D industry which distinguishes it from "in-house" development situations.

The second principal advantage to a customer of the industry is that he incurs bounded liabilities. The development requirements which he has could be met by an in-company research department; this, of course, is the common situation of many companies. However, the research department will continue to exist after any one specific development situation has passed, and unless the company has a steady and continuing research requirement the research department may then appear to be an unproductive overhead expense which the company would be better without. In contrast, by buying the research effort from the contract R & D industry the expenditure is incurred in known quanta, with no continuity of obligation. This is the classic logic for using any contract facility, although it is a relatively recent notion to consider buying research effort in this way.

Range of skills

A prospective purchaser of contract research effort also has available to him a very wide range of technical skills. In the UK, he is able to select from companies having very highly qualified experts in fields ranging from, say, metallurgy to toxicology; from electronics to pneumatics. The aggregate turnover of these companies is well in excess of £10 million per annum, which is equivalent to a very large research department indeed. The whole spectrum of this vast technical resource is in reality available to any one prospective purchaser of technical effort. Publications such as the

Register of Consulting Scientist and Contract Research Organisations (see page 6) give detail to the almost boundless range of skills available. This abundance of skills suggests that it is unlikely that an appropriate source of technical effort cannot be identified, but it also underlines the importance of the prospective purchaser "shopping around" to ensure that he has an appropriate match to his requirement.

With such a large range of skills available, it is not uncommon for a client company to purchase technical effort to complement its own. Thus the whole development project is not contracted out; but where a part of that project requires skills not available in the client company, the "missing" effort can be bought in. Thus, for example, a company with established skills in chemistry may buy electronics development effort as required, rather than establish a whole new in-house resource in an area of which they have little experience. This complementing of resources can be a most effective way of using the industry. Also, of course, a company may simply buy development effort at times when its own resources are already fully occupied with development work.

An important point to note is that the larger contract research companies contain within themselves a substantial spectrum of skills and commonly it is the combination of these skills which give the ability to assemble a multidisciplinary project team which will be able to produce the most original and effective response to a stated requirement.

Climate for innovation

Despite the aggregate of talents and total turnover of the industry, most companies engaged in it could be described as "small". Ignoring university departments and independent consultants, the average contract research company employs between 100 and 200 people. This is, in fact, a further advantage of the industry—since the vitality and urgency inherent in a small company, particularly one that earns all its income by carrying out research work, ensures that the work which is carried out is efficient and cost-effective. Each client is known to have a time and money deadline, and the company stands or falls by its performance on each of the development contracts it is progressing. These pressures are all positive in producing an environment in which research and development will be carried out in a businesslike and thorough way.

It is a known fact that small companies in the UK make a disproportionately large contribution to innovative ideas and new product development. This is in part due to the vitality and urgency already referred to which means that the company must produce these innovations in order to thrive, and that everyone involved in the company knows it. The intimacy of a small company is a very important ingredient in the contract research industry in establishing the fertile scenario in which creative ideas can originate. A society of trained graduate engineers and assistants all actively engaged on a diverse range of

development projects each with his own speciality and interests, all working under one roof for one company, is about as close to the ideal spawning ground for original technical ideas as one could hope to achieve! The net result is that a contract research company has an enhanced chance of originating a novel solution or response to any stated technical problem or requirement.

Future developments

More recently, some contract development companies have begun to originate for themselves new product or process ideas founded upon their own "internal" creativity. This seems an important evolutionary step in the growth of the contract R & D industry, in that it no longer requires the initiative of potential customers to identify and state the problem or requirement. Since these products or processes are proposed by the development companies themselves, there is obviously a danger that they will originate from a "technology push" rather than a "market pull". Contract research companies are thus becoming increasingly sensitive to the fundamental importance of a development project being grounded on an identified market need. By combining this market awareness with its already established technical development competence, the contract R & D industry seems poised to embark upon even more rapid expansion and become a major source of technical developments in Britain.

WHO DOES WHAT AND WHERE?

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Protecting the public

Donald Jolly

is director of
information at
Huntingdon Research Centre

In days of old, the healing professions gathered their nostrums from plants or natural chemicals derived from the soil. The materia medica of the pre-war era, with some exceptions, were much the same as those of the preceding thousand years. Their therapeutic indices had been well established throughout the ages by experience, protracted trial, fatal errors and by incidental experimental work—such as when Socrates demonstrated, unequivocally, the toxic nature of hemlock.

The discovery by the research chemist of his ability to devise new synthetic compounds of remarkable potency and diverse actions, heralded the advent of the "wonder drug" era. Unfortunately, this age has now been darkened by the discovery that these new compounds do not always confine their activity to the target organ or organism. Some of the much-vaunted "wonder drugs" have unsuspected, undesirable and uncontrollable side effects—as in the grim and well publicised case of thalidomide, which soothed the mother while wrecking the bone metabolism of her unborn babe. A less dramatic, but more universally

Several British contract laboratories have established themselves as working watchdogs for consumer safety, devil's advocates for the law maker, and counsellors for the manufacturer

applicable example, is that of the potential penetration of the organochlorine pesticides into the bodies of most creatures, great and small, who share this planet with man.

To combat this menace of the unsuspected side effects, and to reduce the hazards of the "hit-and-miss" methods of product evaluation favoured by industry, a new branch of biological research has been created. Called toxicology, or more accurately "safety evaluation", it comprises extensive and detailed investigations into the mode of action, metabolism, acute and long-term toxicity, teratogenicity, carcinogenicity and mutagenicity of new compounds which might affect man, his animals or his environment. These procedures are now a legal requirement in most countries.

This sudden upsurge and vast extension of toxicological work into the research and development effort of the pharmaceutical, chemical, food and allied industries has created serious practical problems. Each conglomerate of manipulated molecules is examined for any sign of pesticidal, fungicidal, anti-bacterial, pharmacological activity or any other

useful marketable properties. Money, laboratory space, equipment and laboratory animals are allotted and allocated to accelerate and diversify this screening process. Research directors were therefore dismayed to find their animal houses were being occupied by substantial numbers of animals on long-term chronic toxicity studies—such as a two year carcinogenicity test. Furthermore, their research workers were taken from the routine screening procedures to undertake "one-off" toxicological exercises with which they were unfamiliar and for which they were often ill equipped.

Call for contract research

Since compounds which had acquired the status of requiring full toxicological treatment were usually the subject of a patent, companies were willing to arrange for these studies to be completed by outside laboratories. The few independent contract research laboratories which were operating in the life sciences area at the time accepted the challenge with entrepreneurial élan and, within a decade, establishments like our own Huntingdon Research Centre escalated from an urban

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house with stables converted to laboratories and less than 50 workers, to a laboratory complex on 100 acres and a staff of some 800 people. This particular organisation sprang from a consultant practice for animal feed compounders. In those days, however, the need for contract research by industry in the biological field was minimal—indeed, the concept was almost presumptuous. Research was considered by industry to be a liability and scientists were classed as economic ignoramuses. For these reasons, the capital required to build animal houses and the facilities to support the safety evaluation programmes was not easy to obtain. Research workers in independent laboratories, like the buildings they occupied, had to be versatile, adaptable and practical.

Contract research laboratories of this type now form an essential part of the industrial research organisation. Their main function is the safety evaluation of a wide range of products from medicines to plastic containers for food. Their test procedures have acquired official recognition. Their work must be realistically costed and professionally executed. Aborted tests bring no money; inefficient work loses clients; and excessive costings merely drive the client companies to look elsewhere or extend their own research facilities.

Today, governments are producing an ever-increasing mass of Acts and Statutory Instruments designed to protect the public, animals and environment from real—

and sometimes imaginary—bazaars of new compounds. Independent of both parties and free from company bias or bureaucratic pressure, contract research laboratories can mediate with the authority here and help to guide industry. They can also bring an objective approach to each problem, and their staff are spared the embarrassment of the in-house toxicologist who would have the unenviable task of decrying his company's "promising products". Independence and objectivity are essential in safety evaluation, which represents a form of crime prevention.

Tests on animals

Most safety evaluation tests are an exercise in brinkmanship. The insult to the test animals must be adjusted to demonstrate a clinical effect and reveal any biochemical or morphological defect induced by the test compound, without causing undue distress or death. A diagnostic screen must be applied effectively to the test animals, and interpreted accurately. Effects induced by natural diseases, dietary deficiencies and inherited anomalies must be differentiated from those of the test compound. Many of the diagnostic procedures employed measure minor aberrations in enzyme levels. Animals are an unreliable research tool, but data relating to anomalies in animal behaviour become more valuable when the clinical signs are studied in the light of a wealth of background information relating to the species in-

involved. A teratogenic study using New Zealand white rabbits, for instance, is more realistic when any minor deformities in the young are compared with those found in 18 000 untreated neonatal rabbits of the same strain.

Successful safety evaluation certainly needs healthy animals which must be well housed and maintained. But the prime requirement is still experience. The larger contract research laboratories may be carrying out more than 50 test procedures at any one time. Those engaged in such work absorb much invaluable information concerning the idiosyncrasies of some animals to particular drugs, and are also able to select the more significant diagnostic procedures required to evaluate the test compound.

The safety of consumers has become a major political issue. Consumer protection societies and the news media are quick to demand an inquiry into any calamity associated with the use or misuse of a product. The disclosure that the disinfectant, hexachlorophene—widely used by surgeons and hospital staff—caused damage to the central nervous system in animals was soon followed by the disturbing discovery that it had a similar effect on babies. In future, contract research laboratories may be concerned not only with new products, but also with compounds which were accepted before routine safety testing was established.

The conservationist and antipollution lobby comprise another powerful group

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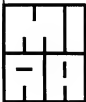
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which will draw increasingly on safety evaluation tests, the results of which should be linked to proposals to alleviate pollution. In addition, contract research laboratories should be able to recommend methods by which toxic waste products or smokes could be rendered innocuous. Another area in which these investigations can be of service is in "total impact" studies involving the effect, relationship, interference and interplay of a new factory, power station or reservoir on the fauna and flora, both macroscopic and microscopic, of the environment.

Safety evaluation is becoming increasingly important in many other areas, including cosmetics, household products, foods, food additives, and containers for food and smoking materials (tests for the latter are currently being considered by the Hunter Committee). The long list of commodities to which safety tests are applied includes paint, building materials, toys, aerosols, industrial solvents and colouring agents for fabrics.

Although contract research laboratories in the life sciences field are concerned mainly with toxicology, they may become involved with inquiries into consumer complaints and product quality

control—when independence again becomes an indispensable asset. Data on quality control and shelf life are now needed to support an application for a product licence; the establishment of cold stores and high temperature cabinets with humidity control for assessing shelf life is another area to which contract research can contribute.

It has been estimated that seven years elapse between conception and marketing of a new product and the cost is 50 per cent of the research and development budget—which may itself well exceed £1 million for a minor medicinal product and £5 million for a major pesticide. By undertaking the safety evaluation tests, contract research laboratories leave industrial workers free to develop new compounds, while the new techniques developed in contract laboratories may help to reduce the number of animals involved and the time and money spent on toxicological investigations.

The spur of competition among the various contract research laboratories arises also from their independent status and has, in turn, led to the development of new evaluation techniques saving both time and money. The manual, monotonous

and labour intensive procedures which used to be inherent in many branches of toxicological investigation are gradually being replaced by equipment, such as the autoanalysers, which rapidly and efficiently process and print the results of a wide range of blood enzyme determinations. Clinical pathology laboratories equipped with these machines can perform many thousand tests a month. The Quantimet Image Analyser, for instance, which we adapted at the Huntingdon Research Centre for assessing histopathological damage, can quantify cellular morphological defects at a rate of 1500 slides an hour; a pathologist would be hard pressed to read 300 slides a day without undue fatigue. The capital outlay on such costly equipment is justified by the continual use to which it is put in the laboratory.

While the end result of these exercises—the safety of the consumer—must not be jeopardised, the increasing expertise inherent in the contract research laboratories must be channelled into devising ever more efficient and streamlined safety evaluation systems. Indeed, unless this happens, industry may find further research unrewarding—in every way.

Choosing the right contractor

Edwin Liddiard

is honorary secretary of the Association of Consulting Scientists and editor of the Register of Consulting Scientists and Contract Research Organisations

If you were to ask any user of contract research how he chose his contractor he would probably answer "on the basis of previous experience or personal recommendation". Such a reply would show how poorly our scientific and technical services are organised and recognised. In choosing a suitable consultant or contract research organisation, the first consideration must be to find the man or laboratory with the most appropriate knowledge, experience, and facilities for tackling the specific problem. There are, however, other important desiderata—especially when commercial interests are involved. A question of divided loyalties may arise if the contractor's first duty is not to his client. No contractor should act contrary to the public interest, but the interpretation of this phrase is often (and, indeed, usually) subjective, particularly when the subjectivity is political.

Politics in some form may well influence the contractor when he is a government department, or a university department, or an employee. Academics may be influenced not only by the government that provides their grant, but also by politically minded student bodies. The first duty of any employee is to his employer and civil servants owe theirs to the establishment; the professor, lecturer, or teacher to his university or college. This may not often be significant, but there is always an attitude of mind which may inhibit giving first priority to the needs of the client and

Granted that Rothschild's customer-contractor principle applies equally to industrial as well as government research, the question for the private customer is where can the best brains, expertise, and experimental facilities be found?

accepting legal responsibility for opinions expressed or results obtained. Government establishments, in particular, tend to avoid anything likely to involve dispute or legal action, unless in defence of their department or in prosecution on their behalf.

Security may also affect the choice. There is no such thing as complete security, not even in-house, since employees may leave or be the victims of commercial espionage. Here, again, attitudes of mind are important. Universities generally like to be able to publish results—particularly, when work is done by post-graduate students. They are not by nature security minded. Visits and visitors are usually frequent and welcomed. Political considerations apart, security is likely to be better in most government establishments than in universities. Research Associations, by contrast, owe allegiance to their members as a whole and, since most of their members are in competition with each other, it may be difficult to do strictly confidential work for one member, or to keep other members from guessing what goes on when they visit the laboratories in which they have a share.

Where speed in arriving at a result is important, universities and government establishments are generally at a disadvantage compared with the independent sponsored research laboratories, since other matters are likely to have priority. Lectures and other teaching

duties or urgent departmental duties must precede private or outside work. The independents, on the other hand, appreciate that their livelihood or continued existence depends on satisfying their clients.

There has, of course, long been a tendency of professional men and organisations in Britain to avoid advertising and other overt promotional activities. This attitude is changing somewhat, and not before time. The first step was taken by professional institutions, such as the Association of Consulting Engineers and the Royal Institute of Chemistry that publish lists of members who do consulting work and are sometimes prepared to advise intending clients as to suitability. Recently, the RIC has lifted its ban on advertising to the extent of allowing dignified promotional activities.

The consulting engineers are usually in a happier position than the scientists and technologists. They are often assisted in their search for new contracts by the government through trade fairs and exhibitions, and by the British Consultants Bureau (partly financed by government), as well as by their own Association of Consulting Engineers. Management consultants are well catered for by the British Institute of Management and by the more selective Management Consultants Association, and they put a good deal of effort into promotion.

The scientists and technologists, by contrast, are less well situated. In addi-

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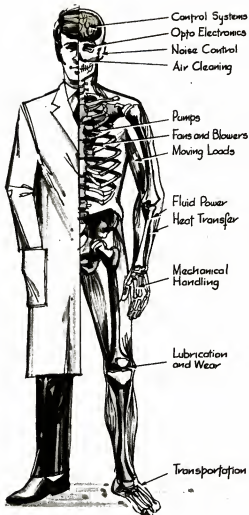
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tion to the RIC, lists of industrial consultants are available from institutions representing the metallurgists, biologists, and corrosion technologists. But the only organisation covering all the science and technology disciplines is the Association of Consulting Scientists, whose membership is small (at present 45) but increasing in number. Most of the important contract research establishments are members and their total income was recently estimated to be in the region of £7 million per annum.

Customers requiring the services of a government department must look outside these lists of professional and independent consultants. Intending users should apply to the Department of Industry. In 1970, the former Department of Trade and Industry issued a booklet, "Technical Services for Industry", setting out the services available from government departments. It is now unfortunately out of print and I have not received any assurance that it will be reprinted or updated, nor can I confidently recommend any particular person, section, or department who can give advice.

The situation regarding university and technological teaching establishments is also far from satisfactory. Many universities have their own liaison officers or organisations. Examples are Loughborough Consultants Ltd, Iscol Ltd (Lancaster University), The Centre for Industrial Consultancy and Liaison (Edinburgh University), Scientific Aid to

Industry, University Consultant Services Ltd, and Bioassay Ltd. The DTI used to run a series of Regional Industrial Liaison Offices, but these have been discontinued and the overall organisation of university contract research facilities is practically non-existent and is left to individual universities or, more commonly, university departments and some private entrepreneurs on the academic staff to do their own promotion.

The only guide including all the above categories of consultants and contract research facilities is, in fact, the Register of Consulting Scientists and Contract Research Organisations, the 2nd edition of which has just been published. This attempts to collect and cross-index all those offering their services in the field of science and technology covered by the Council for Science and Technology Institutes. It is not claimed to be complete, but it contains over 1000 entries cross-indexed under a similar number of subjects. It is hacked by a card index which assists the registrar in selecting suitable consultants or contractors by amplifying the information in the register—particularly, in showing specialised equipment and facilities.

How much?

Costs of consultancy and contract research are often basically unimportant in relation to the quality of the work, since so much more financial commitment may hang on the answer. Nonetheless, research directors usually have

limited budgets, particularly for external work, and this can mean much more cost consciousness.

Fees by individual whole-time consultants usually range from £30 to £125 per day, in addition to travelling and other expenses. The actual fee charged is mainly determined by overheads. An individual consultant who advises on the basis of his knowledge and experience, without doing any experimental work, will be in a position to charge a lower fee because of his lower overheads. Contract research establishments usually have higher overheads, which include high depreciation charges and expensive maintenance of plant and equipment, in addition to the normal overheads of a laboratory such as heat, light, secretarial assistance, library, and other services. The cost of employing the average graduate, with his laboratory assistants, in a modern, well-equipped contract research laboratory is in the region of £12,000 a year and the hourly rate would be about £8, which would include some support staff, but would not cover the use of very expensive and sophisticated apparatus, for which an additional hourly rate would be charged.

If the problem involves the use of highly sophisticated equipment and difficult experimental techniques, as well as knowledge and experience, the larger contract research organisations have an obvious advantage over an individual expert. When a multidisciplinary approach is needed, there is the added advantage

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This advantage may be even more marked in universities. In terms of man-hours, by far the cheapest way of carrying out research is to sponsor a post-graduate research student. This sometimes costs as little as £800 per year. Traditionally, however, the universities take the view that research students are there for training, and that it is more important to train the student in research methods than to get results.

Part-time consultants are, on the whole, cheaper than full-time consultants because their overheads are low, but fees vary widely. Some eminent part-time consultants charge fees in excess of £120 per day, while others less well known are prepared to work for as little as £10 per day.

In the case of government laboratories,

the fees charged are usually at least as high as that of independent consultants and private contract research organisations, since the overheads often also take into account the very considerable capital cost of much of the equipment in government laboratories and Research Associations. Salaries of scientific civil servants are certainly not less than those in private industry. However, government laboratories may sometimes be persuaded to do certain types of work in the public interest, in which case charges will be low or non-existent.

Looking to the future, there is an obvious need to improve the organisation of scientific and technical services in Britain. The Council for Science and Technology Institutes (CSTI) seems an appropriate body to do for the scientists what the Council for Engineering Institutions (CEI) has done for the engineers,

and the Association of Consulting Scientists (ACS) could stand in the same relationship to the CSTI as the ACE to the CEI. Perhaps the proposed title "Chartered Scientist" (CSci) might be adopted for members of the CSTI constituent institutes.

There is a need to protect the status and interests of consultants and research contractors. The ACS, working closely with the CSTI, could deal with such controversial matters as codes of practice, legal liability and indemnity, standard contracts and fees, as well as with promotional exercises in the interest of the profession as a whole—including publication of a register, participation in trade fairs (particularly overseas), acting as brokers for scientists and technologists, and arranging for multi-discipline projects requiring consortia rather than individual participation.

Three golden rules of contracting

Dr Frederick Clarke

has been involved in Harwell's contract research activities since 1965, and is currently marketing director

Where contract research involves innovation, extra special attention has to be given to the marketing side, as well as the technical aspect, of the project. There must also be total commitment by both contractor and client and, ultimately, complete transfer of the technology from one to the other

Innovation means much more than merely taking an idea through its research and development stages. It embraces the equally important activities of marketing, production and sales. This vital fact is often not fully appreciated. And from it springs three golden rules about contract research at the innovative (as opposed to technical service) end of the spectrum. These can be summarised briefly as: first, there must be a marketing, as well as a technical, input to the research programme; secondly, there must be both customer and contractor commitment to the success of the innovation, and not just to the immediate success of the contract; and thirdly, the programme should result not just in information transfer to the customer (as in the case of technical services) but also in technology transfer.

The first rule emphasises that the technical innovator must understand the total operating environment, skills and limitations of both the customer and (if different) the user of the technology. It is rarely good enough to take some general statement about these from the person placing the contract—especially when it is his customer that will be the user. Marketing people are always emphasising that, to quote Peter Drucker, the American management specialist, "What people in the business think they know about their customers is more likely to be wrong than right." Such marketing wisdom, says Paul Jervis, formerly of the Science Policy Research Unit, Sussex, and now at the Oxford Centre for Management Studies, is as true of technological innovation as it is in the much wider commercial context.

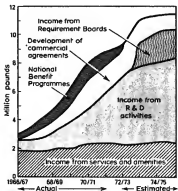
The fact of the matter is that the innovating team must do its own digging into the whole background within which the technology will be developed and used. Furthermore, this marketing background has as much to contribute to the course of the innovation as the technical component. It should therefore be part of the thinking of the innovating team right from the outset.

This latter point has a very interesting motivational and management consequence if one explores it a little further. The research scientist is familiar with his own discipline. If nature goes against

him, he will recognise the point and either try to get round it or give up. Furthermore, he will know how much confidence to place in all the paraphernalia of scientific processes and apparatus that has led him to his conclusion, because he both understands and has control over it. Briefly, he knows and trusts his own professional knowledge and experience.

Consider now the wider innovation context. Here we are saying that his research work should be influenced also by a marketing input. This raises problems. First of all, marketing represents another way of thinking—another discipline. It is in this context of innovation, a less exact and more qualitative discipline than the researcher's own; it can even embody such exotic concepts as social behaviour and attitudes. And to cap such difficulties, the marketing work will probably be carried out by someone else, outside the researcher's own organisation, who talks another jargon and who is continually complicating the whole thrust of his technical thinking. Of course, some scientists are born innovators and quite naturally gather both technical and marketing elements into their thinking. But such people are comparatively rare.

A number of studies including the well-known Project SAPPHO suggest that, if they are to be successful, most innovators need specialised marketing help to guide their judgment. Different contract research organisations tackle this problem in different ways. One approach that we at Harwell have made stems from recognition that at the root of the problem is the fact that marketing



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professionalism is often outside the organisation over which the scientist has immediate control and influence.

That the marketing information and ideas are coming from someone the scientist may not know as a colleague, from a discipline that he does not understand, sometimes gives rise to the (perhaps intuitive) worry that to acknowledge its force in these circumstances is to lose some control over the direction of his work. This would be highly undesirable. Successful innovation is founded, not in a committee process, but on the motivations and energies of entrepreneurs. The marketing input must inform the judgment of the entrepreneur, not replace it.

What we have done to help overcome this problem at Harwell is to train scientists and engineers to operate professionally in the marketing function, and then to place them back in the scientific areas of operation where they can carry the thrust of the marketing logic as fully integrated members of the project teams. The basic idea is to give the technical innovators the same access to, and the same type of relationship with, the marketing function that they have vis-a-vis the technical function. Although we started this development only a year or two ago, there are already signs that it is having success. Our scientists and engineers are increasingly building this new knowledge into their work and planning and, as a result, customers are beginning to include specific marketing components in their contract research programmes.

It must be emphasised that none of this replaces the normal close interaction with the customer, or his regular monitor-

ing of progress, that most contract research organisations like to set up. In the case of innovation, it is particularly important for there to be an identified person in the company with a definite commitment to the success of the project. And it is a crucial job of senior management in the customer's organisation to provide the degree of backing that will give their own staff such commitment and motivation. This is part of the second golden rule mentioned earlier. It may seem obvious, but Project SAPHO reminds us that it requires emphasis. It can be a key factor in determining the success or failure of the whole innovation attempt.

If the contract research is successful, then the customer may decide to make a much larger in-house commitment of resources to take the innovation along the further development, design, production, marketing and sales steps to commercial success. This brings us to the third rule: that it is not just information which is to be transferred, but the whole understanding—both explicit and implicit—of the science, the user, and the market which has to be embodied in the total innovation.

This particular stage in the transfer of technology is sometimes assumed to be in itself a major risk to the innovation. But the central point of the technology transfer argument is that, if things do fail at this point, it is more likely to be due to neglect of the factors mentioned earlier than because of the inherent difficulty in the step itself.

If the innovating team has encompassed both marketing and technical factors, and if the customer has been involved and committed to the success

of the work from the beginning—then the technology transfer step need not be the barrier that is often assumed. It is, however, important that the contractor's staff are committed to the success of the innovation as opposed to merely the success of the contract. To aid this, it is desirable for the staff in the contractor's organisation to know in advance that they will continue to be involved in the innovation, even when it has left the contractor's premises. For example, the contractor may transfer his staff to work for a time at the customer's premises, or it may more simply be decided that he should join in the further progress meetings that the customer's development staff will hold from time to time. These are all fairly simple arrangements that can easily be made between the customer and the contractor. But if they can be planned from the outset, then so much the better because things can look deceptively easy when the contract ends and the need for further involvement may not be seen at the time.

Industrial contract research in the UK has grown dramatically in recent years from around £4 million in 1966 to perhaps £35 million in under a decade. The 1974 customer looks to the contract research organisation for good technical research. But, increasingly, he also expects the contractor to look and think beyond the science, and beyond the contract itself, to the success of the company's ultimate aim of doing the research. The contract research organisations have certainly responded to this by broadening their professionalism to encompass the customer's wider business interests.

Getting your money's worth

Michael Dewey

works at Fulmer Research Institute, Stoke Poges, Bucks

Having selected a contract research laboratory, the customer must ensure that he uses it in the most efficient way possible, in order to complete the project successfully at minimum cost. It is not sufficient for the customer, having commissioned a project, to sit back and wait for the results to be communicated to him. Nor is it satisfactory for the customer to nominate one of his probably already overworked R & D staff to monitor the project in addition to his own in-house research activities.

Executing a contract research programme, and implementing the results successfully, requires considerable effort not only by the contractor but also by the customer. This vitally important principle has often unfortunately been overlooked by the laboratories themselves and by their customers. The reason for this lies in the post-war development of contract research in Britain. During

Contract research organisations operate on the customer-contractor principle, but not always successfully. Positive steps have to be taken by both sides to integrate the research project into the customer's corporate R & D objectives

the decades following the Second World War many contract research laboratories had a vast market—the government. Large sums of money were spent on R & D by the ministries concerned with defence and atomic energy. Our own laboratory, Fulmer Research Institute, was fairly typical of the time—over 50 per cent of its funds in 1960 being supplied by the Atomic Energy Authority, together with a further 25 per cent from other government departments. This situation lasted through to the mid-1960s. Since then, however, the government has reduced its funding of research as a matter of policy, forcing many contract research organisations to seek alternative sources of funding—namely, industry. Fulmer, for example, now obtains over 60 per cent of its sponsorship from industry and less than 40 per cent from government sources. Meanwhile, its total income has increased since 1960 by

no less than 500 per cent.

By definition, the R & D projects carried out by a contract research organisation are subject to rigid control over expenditure—even the completion date for the project usually being decided before the work is started. The work is subject to strict conditions of confidentiality and commercial security, and the names of sponsors or the results of R & D assignments are not divulged except at the request of the sponsor.

Most projects are sponsored by a single client. Recently, however, multi-client projects have become more popular—pioneered largely by the US contract laboratories, such as Battelle and the Stanford Research Institute. Such multi-sponsor projects are usually possible only when the results of the programme have limited competitive usefulness—such as a testing programme designed to benefit all companies in a particular

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industry. In some circumstances, however, it is possible to undertake projects likely to have proprietary interests on a multi-client basis. One formula pioneered at Fulmer for a project to develop a chemical vapour phase deposition process for tungsten carbide, so providing wear and erosion resistant surfaces, involves limiting the right to exploit the process to certain non-overlapping applications for each sponsor.

Most contract research organisations are prepared to devote some of their income to project development activities—10 per cent of annual turnover being a typical figure. Such activities usually involve funding of ideas that have been generated internally to an extent which allows the idea to be "sold" to a client, who then funds its further development. If the idea involves patentable inventions or significant know-how, the contractor will normally retain some rights, and negotiate either a lump-sum payment or a royalty on sales when the idea is exploited. Patentable inventions and know-how which are developed during the project at a sponsor's expense are of course the sole property of the sponsor.

Greater flexibility

Compared with the company's own internal laboratory, a contract research organisation is usually reckoned to offer the following advantages. First, there is the greater flexibility of research budgeting. The maximum spent on a project is agreed before work is started and, in most cases, the project can be terminated at any time, subject to mutually agreed advance notice. Thus there is no long term commitment to the contract laboratory. The independent laboratory ought also to offer better predictability and control over R & D expenditure.

Next there is the ability of an independent establishment to carry out research without the knowledge of a company's competitors. It is often difficult, for instance, for a company to keep secret the fact that it is doing in-house research in a particular area; purchase of specialised equipment, available perhaps from only one outside supplier, can be sufficient to give the game away.

Then there is the multidisciplinary approach generally offered by the contract research organisation, along with the cross fertilisation of ideas it should generate. Most contract laboratories, although tending to specialise on a functional basis (materials, production, instrumentation, etc.), have a broad research base and are able to draw upon a wide experience which is not often available within many company research laboratories. Although contract laboratories maintain strict security, the general experience gained during a project becomes a part of the corporate expertise of that organisation.

It is a common experience of contract researchers to find that, with problem-solving assignments, ideas initiated on one project have relevance to a second project. The functional basis of most contract research organisations also means that corporate knowledge and experience gained with one aspect of

the organisation's work is also applicable, in principle, to seemingly unrelated project areas. (Our 25 years of experience at Fulmer, for instance, specialising in engineering materials with the aim of developing metallic alloys with improved properties is now being applied to polymeric materials.)

Finally, there is the independent nature of contract research. This applies particularly to product testing and evaluation. Many government and local authority regulations require that a product is evaluated in a laboratory, independently of the supplier's data. Such work has been a major factor in the rapid growth of laboratories like Huntingdon Research Centre.

Industrial attitudes

In contrast to the situation in North America, contract research has never become very popular with British industry. As a recent survey published by Interplan called "How to Market Contract Research" showed, contract research organisations tend to be regarded by industry as an auxiliary rather than a full partner—as merely a supplier of services unavailable within the company, or as a means of coping with overload situations. Very few companies, however, appear to have examined the true costs and benefits of in-house R & D. Usually, it is considered to be an internal function as necessary as production or selling.

Industrial companies often justify using internal, rather than contract, research facilities on the grounds that their own staff need to develop expertise with the new technology or product being developed—to solve the inevitable teething problems and develop similar products later on. Links normally between companies and contract laboratories are too weak to allow satisfactory transfer of technology to occur.

Some companies point out that doing the research internally gives them greater ability to recognise and develop spin-off ideas. It is frequently stated that subsidiary ideas developed during research projects are of as much commercial value as the main project, but the research workers need to be familiar with the company's product strategy to be able to recognise the opportunities. Once again, links with an outside contract laboratory may not be sufficiently strong to allow such opportunities to be perceived. Other firms stress that keeping the research in-house gives them greater managerial control over R & D projects.

The real secret of effective use of a contract research laboratory is to integrate the sponsored project fully into the company's own corporate R & D programme. The requirements for a close, integrated relationship obviously depend, first, on selecting the most appropriate organisation for the projected programme. This must involve detailed discussion between the company's representatives and the contractor's scientists and technologists as well as his management. When a company funds a research project at a contract laboratory, it is basically buying the skill and expertise of the staff; and it requires personal

contact to establish that the necessary requirements exist.

Another requirement for close collaboration is that the objectives and scope of the project funded should be very carefully defined at the onset along with any concurrent and subsequent R & D requirements on the part of the customer. Many research projects successfully completed by contract laboratories fail to get exploited simply because the customer failed to recognise the extent of his own in-house commitment to put the development into production. The normal process for defining a project is initially a preliminary discussion, after which the contractor will prepare a written proposal setting out the objectives of the project, how it will be tackled, the staff and equipment to be used, and time and cost estimates.

Some contractors make use of research planning techniques to establish the technical, financial and manual commitment required for any specific project. At Fulmer, for instance, we have developed our own concept, known as Planning Diagrams, which is particularly suitable for planning projects under conditions of uncertainty. These diagrams subsequently act as a vital means of communication between the laboratory and the company. Ideally, the Planning Diagram for the contractor's part of the project should be part of a master Planning Diagram which also shows the customer's commitment to the project.

No collaboration is complete, of course, without frequent and detailed communication between the contractor and the company during the project. It is not sufficient for such communications simply to involve the production of regular (say, monthly) written progress reports. These are a necessary part of the total communication pattern, but verbal discussions by at least telephone are also required at intervals of normally not more than one or two weeks.

Interchange of staff

As the project moves from the research to the development stage, it is also necessary that a frequent interchange of staff should take place between the contractor's laboratory and the customer's factory. This ensures that rapid and efficient transfer of technology takes place when full-scale manufacture commences in the customer's plant. Often it may be necessary for the research staff to work for several months on the customer's premises.

There is little doubt that, because of the greatly increased competition in the contract research business, organisations which can, and do, develop close integrated relationships with a number of client companies will continue to thrive. However, to protect his own independence and maintain his flexibility of operation, the contractor must walk a tightrope between having no permanent customers and few so regular that they absorb all his facilities and time. The rule seems to be that the funding from any single client company should never exceed more than a few per cent of the contractor's total income.



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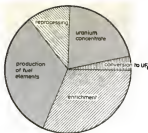
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Your problem project may not be listed here among the short selection of the many research and development projects undertaken by IRD in recent years.

Whatever your interest is, it is probably not entirely new ground to IRD, the largest British-owned contract research organisation. If it is—IRD breaks a lot of new ground too!

Breakdown of nuclear fuel cycle costs shows uranium concentration, conversion to "hex" (UF_6) and enrichment account for between a half and two thirds of the overall cost



ground of South African conditions," wrote Dr A. J. A. Roux, president of the AEB, in a reference to the possible political complications that nuclear development could bring.

Partly because "such a challenging task is, in fact, the only way of stimulating and maintaining the interest of a group of good scientists and engineers," the design of a power reactor to fulfil local requirements was initiated. The resulting PELINDUNA, a heavy water moderated, sodium cooled reactor, was designed to use unclad fuel pellets of natural uranium. All components could, supposedly, have been fabricated locally.

The other possible route to nuclear self-sufficiency was to develop an economically feasible uranium enrichment process. This was where they decided to concentrate their efforts. In July 1970, Prime Minister Vorster told the Cape Town parliament that South Africa had pioneered a successful enrichment process. The announcement perplexed observers who were given no indication as to the nature of the allegedly "unique" process. Vorster confirmed that one reason for the development of the process was to ensure "a guaranteed availability of enriched uranium which, in this difficult world in which we live, implies local production".

But he also emphasised the other obvious incentive for South Africa to enter the enrichment field: the simple matter of economic return. According to present estimates, the production of raw uranium oxide accounts for less than 40 per cent of the fuel costs for, say, a pressurised water reactor (PWR); the bulk of the cost is made up by enrichment and fuel fabrication. As a significant world producer of uranium, with about 150 000 tonnes of U_3O_8 proved (excluding perhaps another 100 000 tonnes at the controversial Rio Tinto-Zinc mine in South West Africa/Namibia, South Africa obviously has to investigate ways of maximising income from its sale.

Nozzle or ion-exchange . . . ?

Against this background, there are two possible hypotheses as to the nature of the enrichment process. The first arises from the involvement of the STEAG group with its current jet-nozzle interests. This, together with the fact that Dr W. L. Grant, project leader of the enrichment project and director general of the AEB, has personally worked on aspects of the nozzle, suggests that the

South Africans are simply developing their own version of this process.

But the jet-nozzle could hardly be called "unique in its concept"—the words used by Prime Minister Vorster, a man not noted for careless statements. And it is not clear how South Africa could attain a lead in a process long pioneered by the West Germans. So what alternatives are there? If South Africa has, in fact, pioneered a new enrichment route, it would almost certainly be derived from its expertise in uranium extraction. Suggestions that ion-exchange could be used would accord with this.

The kinetics of the migration of ions from solution into an ion-exchange resin have been shown to be diffusion controlled. The diffusion coefficient is mass-dependent, so when two isotopes of the same ion are involved, some separation would be expected when equilibrium is reached. The use of ion-exchange for isotope separation is believed to have been investigated in Britain at Harwell, apparently inconclusively. The theoretical attainable separation has in practice been masked by surface effects at, and concentration gradients within, the resin.

The length of exchange column needed to attain equilibrium by conventional means would probably be impractical. But the South Africans are already using moving bed ion-exchange, which could possibly surmount this problem. This sort of physico-chemical process has the advantage over purely physical methods that each stage of an enrichment cascade could be scaled up in size rather than expanded with large numbers of identical units in parallel. The National Institute of Metallurgy (as the GML was renamed in 1966), through its fundamental work on uranium extraction, would be in a position to find the likely combination of resin and solvent.

. . . or liquid extraction

Another possible method of enrichment may have been made practical by work done on the liquid extraction of uranium from the solution obtained by leaching the raw ore. When possible methods of isotope separation were first investigated in the 1930s and 1940s, the Clusius-Dickel "hot wire" process was one of the most promising. In this, separation is attained by a combination of diffusion and convection. In the original apparatus a hot wire was run coaxially down a vertical tube. Thermal diffusion concentrates the lighter component of the gas in the tube by the hot wire, the heavier component at the cold walls. Thermal convection causes the colder (heavy-enriched) gas to flow down near the walls, while the hotter (light-enriched) gas flows up around the wire. The resulting streams gave rapid separation of some isotopes, but the process was not practicable for uranium enrichment.

However, the principle of separation by convection and diffusion is also applicable in liquids. The principle has been demonstrated by a South African chemist working at the National Chemical Research Institute in Pretoria. He described the way in which

similar diffusion and convection systems can be set up by using fluids of different density in a column with porous barriers which block bulk flow and set up individual convection cells. In these, the lighter component is brought to the top of the cell where it diffuses through the porous barrier into the next cell with enrichment taking place at each stage.

Separation effects were recorded with uranium salts but no further work published. The laboratory work only illustrates a possible basis for a large scale process. But any process involving diffusion in liquid is only likely to be successful if non-aqueous solutions are used to avoid the hydration of ions which would effectively mask any mass effects. Here, again, the development by the National Institute of Metallurgy of extraction processes using paraffin would provide a useful basis from which to start.

Last November, the South African government's information service issued a press statement saying: "Scientists had established in recent weeks that South Africa would be able to enrich uranium more cheaply than originally supposed." According to Dr Piet Koornhof, Minister of Mines, "it had originally been estimated that it would be possible to enrich uranium at a cost of 30 to 40 per cent cheaper than by any other means." The pilot enrichment plant—being built at a cost of £50 million—was expected to begin production between April and June 1974. As yet, there has been no further announcement about completion of the pilot plant, though clearly many of the intermediate stages must now be functioning

South Africa's Atomic Energy Board has been reluctant to have the NIM mentioned in the same breath as enrichment, even where a simply historical reference is made to its early role in the uranium industry. This sort of attitude, together with the absence of any announcement of plans to establish full scale uranium hexafluoride production—which would be a major undertaking—can only encourage speculation that the enrichment process being developed does not use the conventional starting point.

Deliberate smokescreen

The South Africans seem quite happy with the confusion. They may simply be using it as a smokescreen to avoid the inevitable political complications that would develop if it were definitely confirmed that STEAG was collaborating technically on the nozzle process. But there is ample evidence that the South Africans have been seeking other partners for financial, rather than technical, reasons. And STEAG could simply be ensuring that if their jet-nozzle work in Germany does not yield a commercial pay-off, they can still share in the enrichment business through the South African government.

Until the South Africans are ready to show their hand, speculation is all we have. Their security is apparently water-tight. British engineers who have worked on the periphery of the pilot plant project have come away with no useful information. Despite their extensive technical contacts, the only response Britons have had to personal inquiries have been requests to avoid such awkward questions. Some scientists in Britain, particularly

those who have worked closely with the South African AEB and uranium industry, are a little unhappy about the idea of their South African colleagues working away secretly in some important new field. They point to the usual reasons, such as the possible duplication of research, and also admit to simple curiosity.

Inside South Africa, information is as hard to come by. The secrecy provisions of the Atomic Energy Act are stringent enough to discourage loose talk. And the odd snippet of information from private industry—such as the whisper that an engineering firm had imported £200 000 worth of computer-controlled machine tool with 17 tooling operations and parabolic machining capabilities, with only six months assured work for it—could simply be a part of the self-sufficiency operations of Armscor, the state armaments manufacturer.

In late 1972, I visited Pelindaba, the AEB research centre, and saw the construction of the pilot enrichment plant underway—on the horizon. The last detailed statement from South African officials confirmed that if the performance of the pilot plant continued to be satisfactory when completed, construction of a full scale enrichment plant capable of producing 2400 tonnes of enriched uranium (with a uranium-235 content of around 3 per cent) would be scheduled for completion in the early 1980s.

The projected power requirements of the new plant is a massive 2000 megawatts. But this presents no difficulty. The Cabora Bassa dam is scheduled to start feeding such an amount into the South African grid shortly. Even without that, South Africa's three neighbours, Botswana, Lesotho and Swaziland, each have power selling plans which they are keen to see developed. Moreover, the new enrichment plant will be built on the edge of the vast Eastern Transvaal coal fields.

Apart from the possible dependence on the Cabora Bassa dam, there may be real political complications because of the use of ore from RTZ's Rossing mine in Namibia to provide the feed for the plant. But initially, supplies from Rossing are only of marginal importance. The bulk of South Africa's reserves are in the gold mines, and there are already stockpiles of concentrates waiting for the uranium market to perk up. There is also at least one worked-out gold mine with substantial reserves of uranium still underground that is being kept open in the hope that it may be economically exploited.

The ability to enrich uranium does, of course, impart a new military potential. It is difficult, though, to see what nuclear weapons have to offer South Africa, which already has conventional superiority over all African countries south of the equator.

The most important political asset that the development of a successful nuclear fuel industry will bring is technical progress and prestige. There could also be useful leverage to be gained as a supplier of both raw uranium and enrichment in the 1980s if predictions of supply bottlenecks are accurate. Is South Africa going to be the Saudi Arabia of nuclear fuel in 1984? It could just be.

Feedback

European patents snag

The EEC Commission seemed delighted when the first Convention of European Patents was signed in Munich last October by the nine EEC member states, plus Switzerland, Sweden, Norway, Austria, Greece, Liechtenstein and Monaco.

Now, having digested the small print, the Commission has bounced back waving the treaty of Rome opened at the page marked "Free Trade" and send as abrupt note to all EEC members.

The idea of a European patent has been floating around since well before the first inter-governmental conference was called by the Six in 1969.

Last October's signing seemed to be the first step towards the goal of a European trade network uncluttered by nine separate lots of patent legislation and

attendant red tape. The extra signatories were a bonus.

The bogey which has upset the Commission is a protocol tagged on to the Convention which would postpone the implementation of a full-blooded European patent for 5 to 10 years.

The traffic jam in the European Parliament will ensure that ratification is delayed until 1976. So, says the Commission, the protocol "would entitle a patent

holder to forbid the importation of protected products . . . into another member state for a period which could extend to 1986.

"He could thus control the sale of his patented product in the Common Market, cut off national markets as he chooses and charge different prices in each member state.

"This limitation of the principle of free trade contravenes the provisions of the Treaty of Rome."

The rider sticks out like a sore thumb, so why has the Commission taken almost six months to raise the issue?

Not to worry, the Commission has said its piece. There's an 18-day conference booked for all the signatories in May, and there's obviously a lot of nit-picking to be done before the Eurapatent gets off the ground.

Who said 1986?



The future of Gordon and Breach

One of the world's major science publishing houses has filed a petition under the US Bankruptcy Act. Gordon and Breach Science Publishers Inc, with subsidiaries in London and Paris, publishes around 80 journals and periodicals, most of them academic, as well as a great many scholarly textbooks and conference proceedings. The company's growth has been spectacular, for the first academic journal under the G & B imprint did not appear until the mid-1960s. For a while desks in universities were awash with G & B publicity material announcing yet "another important new journal from Gordon and Breach".

Signs of strain from the rapid growth began to emerge recently. Some journal editors, mostly academics paid on a royalty plus expenses basis, became anxious at delays in settling commitments, and one or two small pressure groups were formed. Also, subscribers to certain journals noticed that invoices to continue subscriptions were being mailed several months before the expiry of existing orders. A further point is that the anxiety of librarians over the high cost of G & B textbooks became widely felt.

Martin Gordon, chairman of the board, petitioned the US district court for southern New York on 29 March, 1974, under Chapter 11 of the Bankruptcy Act. English law has no exact equivalent of Chapter 11; under it the creditors can appoint a committee to arrange for the re-organisation of the company's affairs. The summary of the company's finances sets the assets at \$2.3 million (including \$2 million of stock in trade), with liabilities of \$4.16 million. The main creditors are believed to be three banks in New York City who are owed about \$1.5 million. Sundry creditors include dozens of editors, not to mention all the libraries with subscriptions that are only partially fulfilled. It is thought that the banks will

want to proceed with an orderly liquidation—selling journals, books and copyrights on an individual basis—rather than putting the entire company up to the highest bidder. The future of the many journals probably now rests with the attitudes of the existing editors, many of whom are prepared to continue only on a cash-in-advance basis.

What's a man to do?

The path of the righteous is proverbially hard. The April issue of the Soil Association's journal includes a letter from an Oxford soil scientist expressing shock at the discovery that the association's marketing section sells cider in non-return bottles. "Isn't the Soil Association aware?", he asks, "of pollution and conservation?"

The letter draws a reply from Mr John

Chevallier Guild, chairman of the Aspoll Cyder House which advertises itself as using only organically grown, unsprayed apples, with no added chemicals or preservatives. Sheer economics, says Chevallier Guild, have forced him to take "this distasteful course of action" (in violation of a self made vow three and a half years ago to stick to returnable bottles). Half of his trade, he points out, is with London stores and supermarkets chains and they won't take his cyder unless the containers are non returnable. Apart from that, though, there would be the cost of returning bottles from the "more than 500 shops and as many retailer customers" all over the United Kingdom. He feels that his faithful customers are already finding the carriage charge excessively high.

The firm does supply some of the London shops and outlets in East Anglia with returnable jars and bottles but when they do come back many are found to

Portuguese hand the guerrillas a new weapon

The Portuguese coup may lead to improved relations with their African subjects. If, however, the guerrillas continue their campaign, they will soon be handed a formidable weapon. The Cabora Bossa dam, now under construction on the Zambesi river, will be used to generate hydroelectric power at very low cost. The economic viability of the scheme depends very heavily on the export of power to South Africa, which in turn will need the cheap electricity for conventional industrial processes, and to process the newly discovered uranium deposits. The link between Cabora Bossa and Cape Town will be through a d.c.

line 1400 km long, comprising essentially two conductors. Although the Portuguese troops might be able to stop sabotage at the dam itself, it will be obviously impossible to guard the whole line, and quite simple activity could keep the circuit open. To compound the problem, the transmission system involves some untried technology. It is the most powerful and longest d.c. link under construction, and (if allowed to) will transmit 2000 MW at around 533 kV. Britain has only one d.c. transmission line—the link with France—but another the Kingsnorth link, is to be opened soon, after a run of technical difficulties.

have been used to hold petrol, are thus unwashable and have to be smashed. Mr Chevallier Guild observes sadly that, until the government bans non return bottles, businesses of his size will have to toe the line or shut up shop.

Dropping the 'Science' title

When Harold Wilson formed his first government, he appointed a Chief Scientific Adviser. Although British governments had had scientific advice at Cabinet level in the past, this was the first formal recognition that such was the case. And it has lasted just 10 years. Following the resignation of Sir Alan Cottrell as chief scientific adviser, the government has retained his former deputy, Dr Robert Press, to advise it on scientific and technological matters. Dr Press, however, retains his title and salary of Deputy Secretary, Cabinet Office, and does not assume the title of Chief Scientific Adviser.

Both the Chief Scientific Advisers of the past decade, Lord Zuckerman and Sir Alan, were active scientists with high reputations for their academic work. By contrast, Press has spent much of his working life as a career civil servant. Educated at Queens University, Belfast and Trinity College, Dublin, he worked as a physicist in war department research in the UK from 1941-1943, and in India from 1944-1946. Subsequently he has been, among other things, an attaché at the British embassy in Washington, a member of the British delegation to the

Conference for Discontinuance of Nuclear Tests (1958-1959), and Assistant Chief Scientific Adviser (Nuclear) at the Ministry of Defence. Since 1967, he has worked in the Cabinet Office. Dr Press is 59, a year short of the age at which it is normal practice for senior people to retire from the Civil Service. However, he will not necessarily retire within a year; Lord Zuckerman remained in the Cabinet Office until he was 67.

Drive the roads and scatter...

Naturalists can get very stropy when someone interferes with what they regard as the "natural" distribution of wildlife.

Some 60 years ago, for example, there was a Lepidopteran cause célèbre when the European map butterfly (*Araschnia levana*) was introduced into the Forest of Dean. It flourished for several years, but was eventually ruthlessly exterminated by a single collector who disagreed on principle with its introduction. Fortunately or otherwise, there are signs that such interference may be on the increase. This spring for example, the catalogue of the well-known Ipswich seedsmen Thompson and Morgan, offers not only their usual splendid range of esoteric flowers and vegetables, but also the pupae of peacocks, small tortoiseshells, and marsh fritillaries for their customers to rear and release in their gardens. Though the first two butterflies are found almost everywhere in the country, the Marsh Fritillary is local and sporadic, forming sharply defined colonies



in swamps and damp meadows, and also occurring on chalklands where its food plant (the Devil's Bit scabious) occurs. Although at £3.22 for 10, not many Marsh Fritillaries are likely to be artificially scattered, even a few spurious records might to distort the entomological distribution maps. Mercifully or not, without its right food plant, in this case the Devil's Bit scabious, the marsh fritillary will be unable to breed.

Our rare wild plants are also now to become involved. In the spring issue of the magazine *Drive*, ringing phrases like "save wild flowers from extinction", "Britain's silent battlefield" (the hedgerows) and "halt the march of the plant despoilers", are being used to tempt members with a special offer of packets of wild flower seeds, including traveller's joy, meadow cranesbill, borage, oxlip, sea thrift, cheddar pink, harebells, to plant these seeds in the wild, but even if they only plant them in their gardens, there is no knowing where these plants will spread once established. However, plants generally grow only where the environment is suitable, and the harebell would be unlikely to thrive anywhere other than in its natural habitat of grazed, limestone turf.

The last word on...

Computerised complaints

The press reported just a little time ago, and with some derision, that a number of people who telephoned the BBC to complain at the abrupt termination of a Panorama interview with Mr Heath, found themselves actually talking to one another, while ostensibly holding on to speak to a duty officer. It was suggested that this "unusual quirk seems common to BBC 'switchboards'" since would-be contributors to BBC Radio London phone-in shows have also found themselves talking to one another with a frequency that has led them to form a club and hold meetings once a week in an East London pub. At which, possibly, they spend their non-drinking time talking to one another on little imitation telephones and communally thinking up tricky catch questions to confound radio pundits.

On longer term consideration, however, some doubt cannot be concealed as to whether the news reporters were justified in poking fun at the BBC's inter-complainant hook-up. It could be held that the BBC, wittingly or not, was actually advancing in the right psychiatric direction. People who telephone to complain are emotionally more interested in vociferously delivering their complaint than in actually having

anything done about it. It is the catharsis of verbal attack which brings them blessed mental relief and leaves them feeling much better afterwards. This dictum is supported by the First Law of Public Complaints, so familiar to all who labour in any form of public service. It pronounces that, "The validity of any public complaint on the telephone is in inverse proportion to the vehemence of its delivery."

Sir Charles Curran may be relieved to learn that a steam-letting-off telephone facility is already in operation in Tokyo. It is known as "The Grudge Line" and anyone who wishes to inveigh against anything whatever can dial its number to be greeted by a tape-recorded feminine voice cooing sympathy and inviting the caller to "yell, grumble, curse or do whatever you like for the next 60 seconds". This grudge line is, of course, only a one-way service since the complainant has to make all the running. The idiosyncracies of the BBC telephone system carries the facility a stage further by providing a two-way service. The complainant coming up on their eccentric switchboard can already be connected to another complainant with exactly the same beef. Not only can each obtain the

catharsis of raving away about the cruelty of Robin Day, but they enjoy the further emollient of doing it to somebody who fervently agrees with every word they say.

The BBC should now allocate a team of telecommunications engineers to the development of this present chance facility into an official Computerised Complaints Centre. Then, as incensed customers call up, each would be met by a tape-recording of Susan Hampshire sweetly inviting them to name the time, date and title of the programme that has outraged their delusions or offended their prejudices. The attendant computer would register these facts and duly connect the fire-breathing caller concerned to another belly-acher voicing the same complaint. And then allow them to agree violently with one another for a full five minutes. After which time, the voice of Susan would gently return to thank them for calling, assuring them that their words have been recorded for later consideration, and promising to send them a free copy of next week's Radio Times and a packet of throat pastilles. Not only would this system give fuller emotional satisfaction to aggrieved listeners but it would also release all those BBC duty officers for closer attention to other important aspects of their duties.

Patrick Ryan

Review

Spring books

Concept of prospective

by Dr William Letwin

Shaping the future

edited by André Cournand and

Maurice Lévy

Gordon and Breach, pp 300, £8.10

What makes the work of Gaston Berger (1896-1960), a French futurologist, especially interesting is that he recognised the essential paradox inherent in the activity of forecasting, overlooked or ignored by other futurologists.

The paradox is this. If the course of the future were inexorably determined by gods or nature, then true seers and oracles could foretell with certainty what will happen (be it the murder of Agamemnon or the withering of Capitalism); but then men would be powerless to influence affairs, being victims rather than actors despite their illusions of purpose and power. If, on the contrary, the future is not preordained, then men can within limits make of it what they will; but then no man can predict the future with any certainty since all men are constantly engaged in changing it. In short, we wish to know the future partly so that we can act effectively, but it turns out that we either cannot know it or cannot shape it.

Some devotees of science think that this paradox can be avoided by making predictions in a conditional form, as for example, "If oxygen and hydrogen are mixed properly, they combine into water", or, to quote Stanley Baldwin in 1923, "If we go on pottering along as we are we shall have grave unemployment with us to the end of time." Such statements seem to foretell the future while offering the possibility that the predicted outcome can be negated by purposive action. This apparent success in avoiding the paradox is totally illusory. A conditional prediction implicitly contains a *ceteris paribus*; it does not foretell what will happen but what would happen if the hypothetical condition were satisfied and if everything else stayed the same; but as any prudent person knows, the rest of the world does not stand still very long. Outside of laboratories and in the long run all sorts of things do change, and in unexpected directions, so that hypothetical conditional predictions can be counted on to be more or less inaccurate as long-range forecasts.

Gaston Berger may have been especially sensitive to the paradox of foreknowledge and action because he was an enthusiastic philosopher. Family circumstances had forced him at first into business, at which he was rapidly suc-

cessful, but a passion for philosophy kept him studying in his spare time and finally, at the age of 45, he passed the examinations that admitted him to a university lectureship. After the Second World War, when he was a leader in the Resistance, he became an academic administrator, and in 1953 was appointed head of all French universities, a post he held almost until his death. His most memorable achievement, commemorated in *Shaping the Future*, was to create the Centre d'Etudes Prospectives, which has become the focal point of French futurology.

Unfortunately, however, though Berger recognised the difficulties of trying simultaneously to foretell and to shape the future, the philosophical essays which he wrote as a programme for his centre do little to resolve the paradox. He urged a "crucial change of attitude" so as to alter our "stubbornly retrospective" culture into a "prospective" one. Part of this change must be to avoid "extrapolating the past". "It is just in such a universe, where everything is changing so rapidly, that forecasting is at one and the same time absolutely indispensable and singularly difficult." This, I would

agree, is the problem. What is the answer? Berger gives little or none. He tells us only that we must establish "research projects", new "social structures" and "a new state of mind". We must make "concrete forecasts" rather than abstract predictions. He gives us, in short, programmatic slogans. The sentiments are admirable, their usefulness negligible. Forecasts made by Berger and his disciples have not been truer or wiser than those of other futurologists. Berger was one of those memorable yet sad prophetic teachers who glimpsed a vision toward which he could find no road. We may honour him but we cannot follow him.

Radical science journal

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Radical Science Journal, 9 Poland Street, London W1V 3DG, 30p per copy, £1 annual subscription (post paid)

"The aim of this journal is to provide a forum for serious and extended analyses of the history, philosophy, ideology and current practice of the sciences from a radical perspective".

This statement on the inside front cover is repeated on the opening page except that the last four words read "within a socialist perspective". It is not clear to me that "radical" and "socialist"

THE PARADOXICAL NATURE OF REALITY

GEORGE MELHUISH

This book represents a revolution in philosophical thinking. It demonstrates that traditional methods of understanding have failed to define primordial flux. An entirely novel investigation into the nature of change indicates that change is possible only in consequence of definitive paradox and actual indeterminacy. Whenever we define things particularly, we use the principle of identity and bring into play the tautological system of logic, wherein everything is what it is. However, the author shows that the innate change of the experiential moment demands that we disclose the non-tautological system of logic. A paradoxically energetic state is used as the basis for the non-tautological foundations and here a thing is not only what it is. A new philosophical cosmology is put forward. It is shown that it is an error of orthodox doctrine to claim that the universe is only something in particular. It is argued that in order to define reality adequately, we must turn away from dogmatic ideas to a discipline wherein the representation of the finite world as a selectivity implies actuality, only in consequence of the representation of the infinite world as a non-selectivity. We are familiar with the notion of a selective universe, but *The Paradoxical Nature of Reality* outlines, perhaps for the first time, the notion of the non-selective universe. £1.90.

ST. VINCENT'S PRESS

Sion Hill, Bristol BS8 4DQ

Dr Letwin is reader in political science with special reference to the government and politics of the US, at the London School of Economics and Political Science

are necessarily interchangeable, particularly in the stated context. Be that as it may, on either basis I would have expected to be among those for whom such a journal might prove valuable. Why, then, does at least this first issue so signally fail to engage me?

The essential clue may lie in the editorial claim that "Our aim will be to avoid scientific and political jargon which makes analyses accessible only to an elite. Such contributions will not be published until they have been translated." Amen, say I. But it does not appear to have worked out quite like that. The problem is, at least in part, one which the editors themselves acknowledge: that the "softer" or social sciences are more readily accessible to analysis of their interrelationship with economics, politics and ideology. Consequently the journal starts off with a greater emphasis on these areas. The editors say that it is an imbalance they hope to correct "as socialist critiques of the natural sciences are built up." A balance would have helped overcome what is certainly in this first issue a tendency toward ponderous abstraction—at least for those more used to a "hard" science such as physics.

The first of three major articles is a survey of "Management Science and 'The Second Industrial Revolution'". On the evidence of this, "management science" seems to consist of various ways of justifying a power structure; the "scientific" content seems to be minimal, although there is no shortage of philosophical and ideological room to

manoeuvre. Unfortunately the argument pared down to as few syllables as possible is that no one ought to tell anyone else what to do. Fair enough—but, if left at that, hardly profound: I must be missing something. Or maybe Mike Hales simply wants to demonstrate that "management science" implies by definition the managing and the managed, and is accordingly suspect. I would have believed it at least 20 pages sooner.

In the course of a detailed and thoughtful dissection of the social roles of technology—not merely the obvious material consequences, but what he describes as the "legitimation" of social circumstances by technology—David Dickson offers some provocative insights. But once again the general flavour of the writing by no means hews to the line laid down in the editorial statement. Someone should surely have translated sentences like "Furthermore, by maintaining the Cartesian split between the abstract world of the subjective and the material world of the objective, the ideology of scientism legitimates the idea that conception of a particular line of action can and should be divorced from execution, and theory from practice." It is one thing to have to think carefully about an idea; it is quite another to have to decipher it. I suspect that the "workers", who appear frequently in the pages of RSJ, would be as impatient with such falderal as I am.

The language problem does not so severely impede consideration of "The Relevance of Anthropology", by Jack

Stauder. Part of the reason may be this article's comparative wealth of specifics: names, places, dates, events. Again, the thesis seems uncomplicated: should an anthropologist study a group of people in order to make them easier to manipulate by outsiders, or not? The choice does not seem to me unduly burdensome—but then I am not an anthropologist.

RSJ 1 concludes with a brief, hostile review of Jerry Ravetz's *Scientific Knowledge and Its Social Problems* (Ravetz's apostasy clearly still rankles) and a long, stimulating review of *Modes of Thought*, by Horton and Finnegan. The journal is well-produced, crisply printed on good quality paper and bound to last. Despite my extensive reservations I hope it does last. But the editorial collective had better collectively edit. *Walt Patterson*

Man against mortality

by D. F. Juniper
Pitman, pp 138, £2-00

This book is as arrogant as it is unconvincing. In seven speculative essays Mr Juniper discusses the morality of man in three main phases—transplants, halts (the stopping of the overall process of bodily ageing), and incorporations (defeating death by physical transfer). This he does against the background of what he claims to be "current views", based on the answers of a small, highly selected sample of 45 articulate people to a questionnaire. One has, of course, to be

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Hardback: Fifth edition April 1974; 224 pages: £3.30
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May 1974: 248 pages: limp cover: £2.95

Further information on these titles and a list of stockists is available from the publishers on request.

CHAPMAN & HALL

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cautious in expressing unduly severe reservations about a book which may merely be "ahead of its time". Justification, however, is afforded by the prospect held out "that, in the not-too-distant future, man will be able to choose between living a normal lifespan or having the process of his mental and physical ageing halted." (my italics). This is so obviously unlikely that it makes one question whether the book is ahead of its time.

Mr Juniper reveals a good grasp of biology and bioengineering, although his analysis must be suspect in the light of his strong suggestions from such limited data. There is a world of difference between combating disease and controlling degeneration. Indeed, there is evidence that, apart from the nature of man, the very structure of our universe may make the latter impossible (see T. R. Griffiths, "A new unifying theory for the initiation of ageing mechanisms and processes," *Mechanism of Ageing and Disease*, vol 2, p 295). Certainly there is no evidence from man to suggest we can halt the ageing process to any degree.

It is in the realm of theology that the author demonstrates the superficiality of his approach. One would be loath to criticise this aspect were it not for the subtitle "Seven essays on the engineering of man's divinity". The bibliography of 17 papers and books contains no reputable theological work, so it is perhaps not surprising to read that man "has got rid of the satisfying original sin and redemption myths." Doubtless the discarding of such truths is a factor in the inability of people to grapple with the problems of present living, quite apart from their aspiring to an "immortality" of the type Juniper envisages. One has more sympathy with the realism of Bertrand Russell: "When we have acquired these vast powers to what end shall we use them? Man has hitherto survived by virtue of ignorance and inefficiency. He is a ferocious animal and there have always been powerful men who did all the harm they could. But their activities were limited by the limitations of their techniques. Now these limitations are fading away. If, with our increased cleverness, we continue to pursue aims no more lofty than those pursued by tyrants in the past, we shall doom ourselves to destruction and shall vanish as the dinosaurs vanished . . . We shall court a similar fate if we develop cleverness without wisdom. I foresee rival projectiles landing simultaneously on the Moon, each equipped with H-bombs and each successfully engaged in exterminating the other. But until we have set our own house in order we had better leave the Moon in peace. As yet, our follies have been only terrestrial; it would seem a doubtful victory to make them cosmic. If the increased power which science has conferred on human volition is to be a boon and not a curse, the ends to which these volitions are directed must grow commensurately with the growth of power to carry them out." ("The Expanding Mental Universe", *The Saturday Evening Post*, Washington, 18 July, 1959.)

I fear that the author's naive inference that "to know yourself is progress" is not

borne out by experience. Psychoanalysts are not necessarily balanced people. I remember as a medical student wondering whether to major in psychiatry, and then after looking at a group of such specialists deciding that either the subject made them the men they were or else they were like it beforehand, and it wasn't worth taking the risk. A considerable time elapsed before I discovered that some men may adopt a profession to solve their own problems (not always successfully) as well as provide solutions.

Since many a successful man has found to his consternation that total success does not bring total fulfillment, the frustration for lesser mortals of a perpetual existence which they dare not relinquish is a horrifying thought. There is a concept of immortality that does not depend on physical longevity, and which is founded on objective reality (Paul, *I Corinthians*, Chapter 15). It will prove a wholesome corrective to deliberate on that concept alongside Man against Mortality.

Verna Wright

The Iron age in lowland Britain

by D. W. Harding

Routledge & Kegan Paul, pp 260, £6.95

Dr Harding's book deals with the surviving remains of those communities who occupied south eastern England in the pre-Roman Iron Age, with special reference to the latter part of the period. The book is divided into two principal sections. After an introduction in which general problems of chronology and classification are outlined, he gives an extended account of the more important structural remains of the period such as settlements, fortifications, burials and religious cities, enhanced by reference to contemporary classical accounts. From this emerges a clear and comprehensive picture of life in the southeast of the country, selectively illustrated by well-chosen examples.

The second major section of the book, under the heading of "Material Remains and Chronology", is, in essence, a detailed discussion of pottery types and objects of fine metalwork, including coins, so arranged as to provide a broad chronological framework. In two short sections the author first outlines the problems of studying the transition period from Bronze to Iron Age—perhaps somewhat underestimating the range of evidence now available—and then considers the new intrusive elements, with their clear links to the contemporary European Hallstatt C and D period, which imply some degree of contact between Britain and mainland Europe at this time. He then turns to a fuller discussion of those British cultural groups which were contemporary with the La Tène cultures of the continent. Here his thesis, elegantly presented, is that sufficient evidence survives to suggest an incursion of settlers from Northern France into Eastern England in the La Tène I period. He is, in fact, updating and modifying an hypothesis first put forward 35 years ago, which has not been much in favour in recent

Nucleus and Cytoplasm

Henry Harris

The text of this new edition has been extensively revised to take account of important experimental advances, but its purpose remains unchanged: to provide an introduction to the most important problems in the field of nucleo-cytoplasmic relationships. The recent development of assays for the biological activity of cellular messenger ribonucleic acids, the analysis of transcriptional and translational controls in molecular terms, and the continuing progress in the field of cell fusion have, however, done much to clarify problems that appeared intractable a few years ago. Third edition illustrated £4.20 paper covers £1.90

The Control of Gene Expression in Animal Development

J. B. Gurdon

This book outlines what is known of the control of gene expression during the earliest stages of animal development and cell differentiation. Special emphasis is given to the experimental analysis of gene regulation in living cells by such techniques as nuclear transplantation and microinjection. £3.50 paper covers £1.25

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years. The case for strong contacts between Britain and the continent at this period is a convincing one, but the nature of that contact will remain a matter of debate for some years yet. Indeed, the very nature of the evidence may always preclude a definitive statement. It was from the cultural groupings of this period, Dr Harding argues, that the powerful Cattuvellanni, the tribe who led the opposition to Caesar, were to develop. That they were not descended from Belgic invaders arriving c. 100 BC is a novel and interesting suggestion.

The Iron Age in Lowland Britain is a well-produced volume which will be welcomed as an important addition to the literature of a hitherto neglected period.

Barry Cunliffe

On machine intelligence

by Donald Michie

Edinburgh University Press, pp 200, £2.50

Since the publication of the Lighthill Report on Artificial Intelligence (see *New Scientist*, vol 57, p 478) the topic of machine intelligence has become undoubtedly controversial and perhaps fashionable as an Aunt Sally worthy of spectacular demolition. This atmosphere gives Michie's book a particularly timely flavour. But as a collection of his previously published popular works, it offers nothing new to the devotee of the field. To others, it offers an interesting and compact collection that ranges from speculations on the nature of something

vague called "intelligence", through the logics of game-playing and problem-solving, to ways of doing so-called "intelligent" tasks on present-day digital computers.

A word of warning, however. On Machine Intelligence might have been better titled "On Donald Michie". This is unabashedly one man's potted philosophy on the subject and the reader will not get a balanced view. Indeed, the derogatory tone with which the article called "On not seeing things" criticises work in laboratories other than Michie's will leave the reader with the feeling that some political hair-splitting is going on.

This type of idiosyncrasy is somewhat regrettable as the book raises questions of undoubted fundamental importance. The most important of these is "What is the best way of understanding human intelligence?" Michie's simple answer is: by writing a computer program that does things which we would all agree are intelligent. The fact that the computer may do the thing in a totally different way to a living being and may, therefore, be telling us nothing at all about ourselves, is ignored. It is also a pity that some points (for example, tree-like searches) seem to be made over and over in several chapters, and that some of the articles, with a strong "futurology" bent, seem merely applications for research money. However, Sir Eric Eastwood's comment in the preface that the papers are "fascinating to read, elegant and persuasive" is true. Also, reading the preface further "... they will be widely read

SAUNDERS TITLES FOR 1974

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By Walter E. Harris, PhD, and Byron Kratochvil, PhD, both of the Department of Chemistry, University of Alberta, Edmonton, Alberta, Canada.

284 pages. Illustrated. March 1974. £3-10.

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By Shelby D. Gerking, PhD, Professor and Chairman, Department of Zoology, Arizona State University.

506 pages. 255 illustrations. April 1974. £5-50.

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In publishing the second edition we have taken into consideration requests for S.I. units to be used, therefore in this edition S.I. units are employed throughout.

By John S. Blakemore, PhD, Florida Atlantic University, Boca Raton.

About 400 pages. Ready May 1974. Approx. £6-75 (Paperback edition approx. £3-40).

W. B. SAUNDERS COMPANY LTD

12 Dyott Street, London WC1A 1DB.

not only by scientists and engineers, but by all those interested in the role of the computer in the modern world" is also significant. The book is about "machines", and not about "intelligence".

Igor Aleksander

Museums of England

by Garry Hogg
David & Charles, pp 112, £3.25

Books about museums are all too rare, and I would have been delighted to welcome this addition, if the author had not set himself the almost insoluble task of describing 60 museums on as many printed pages. Alas, it is no *Baedeker* but merely an illustrated tourist guide.

As such it can be recommended to technologists who have not seen the Motor Museums at Beaulieu and Cheddar, the Ironbridge Museum, the Pilkington Glass Collection and the Newcastle Museum of Science and Engineering.

Mr Hogg, who has written a number of books about English customs and buildings, has had to make the choice of selecting from the 600 odd English Museums, excluding wisely the National Collections in London, those that might appeal most to the tourist who might make a local excursion on a rainy day.

This book will help in many ways to make such visits possible and enjoyable as he they to the Bagpipe Museum in Newcastle upon Tyne, the Musical Museum at Brentford or the Gershom Parkinson Memorial Collection of clocks, watches and time-measuring instruments at Bury St Edmunds. Mr Hogg must be thanked for having pointed the way to these treasure houses, and if a second edition is called for, he might well extend his practice of giving map directions, or even city streets, which in the present he does in only five out of 50 museums mentioned. A page of photographs accompanies each text, and a map of England with museums sites marked, concludes the book.

Anthony Michaels

The next ten thousand years

by Adrian Berry
Jonathan Cape, pp 224, £2.50

The Next Ten Thousand Years is a far-reaching vision of man's future in the Universe, extrapolated to the point in time when the entire Galaxy will become available for human occupation. Adrian Berry's basic assumptions are that economic progress will continue unchecked in the long-term, that we shall not be invaded by interstellar barbarians, and that human nature will not change. A real growth rate of around 3 per cent in the output of developed nations is assumed. This has been achieved historically for only a few centuries; during the Dark Ages in Europe mankind actually slid backwards for hundreds of years. So, Adrian Berry's book is all about man's state after 10 000 years of growth, and this may take a very long time to accomplish. A growth rate of 3 per cent after inflation enables £1 to buy 0.001 Earth masses of gold

after 2000 years, a galactic mass of gold after 4000 years, and 10^{14} galaxies of pure gold after 10 000 years. As there is not that amount of gold to go round the money has to be spent on something else, and this book envisages what the something might be.

The first few centuries are passed by colonising the Moon and building up lunar manufacturing and extractive industries. Soon population growth causes man to look wistfully at Venus. Her carbon dioxide atmosphere is broken down by blue-green algae; within some decades oceans form and the planet is ready for occupation. At later stages flying city-states are constructed in orbit round the Sun. Eventually the planet Jupiter has to be dismantled for its heavy metals so that an enormous biosphere can be assembled to encircle the Sun.

What about the beckoning stars? Spaceships capable of vanishing down the interstellar wormholes of dynamic pre-geometry are constructed. Hey presto! and you zip through superspace in zero time to solar systems far out in the Galaxy. This is about as feasible as making a journey to Australia by means of the uncertainty principle, and is the weakest part of the author's scenario. His incorrect discussion of stellar evolution is also unimpressive. Despite these blemishes, however, the book is a stimulating, thought-provoking, side-slap at the Club of Rome that is great fun to read.

Simon Milton

Patterns 2

Interactions and building blocks (pp 96, 90p); The Diversity of life (pp 96, 96p); Science and decision making (pp 96, 65p) by William Hall, Brian Mowl and John Bausor
Longman and Penguin

The series Patterns aims at stimulating a new approach to the teaching of the sciences terminating in a double O-level. It is to be published in four parts of which "Interactions and Building Blocks" is the second. When reviewing part 1 (New Scientist, vol 61, p 153) I concluded that the approach was suitable only for students of above average ability. After looking at this latest publication this is still my opinion. This does not condemn the series, however, but merely limits it. I would recommend interested teachers first to read the Handbook setting out the philosophy of Patterns.

The main text, Interactions and Building Blocks, is interesting but the layout of some of the visual material could have been improved. There are chapters on competition and predation, electrical interactions, motion, classification and distribution. The strength of Patterns is in its relevance to everyday life—a factor often overlooked in more traditional texts.

The visual presentation of the accompanying booklets, The Diversity of Life and Science and Decision Making, is superior to that of the main text. Errors are few, but in the former the song thrush is referred to as *Turdus musicus* instead of *Turdus philomelos*. I also

The Survey of Professional Scientists 1971

Studies in Technological Manpower No 4

This second survey, which follows the first undertaken by the then Ministry of Technology and the five science institutes in 1968, enables comparison to be made between the incomes and employment of scientists in 1968 and 1971. This survey also breaks new ground in giving a full analysis of scientists by institute. It has also identified the women members of the five science institutes and provides separate analyses of their incomes and employment. £2 (£2.10)

Chemicals Manpower in Europe

This report, prepared by the European Mission team of the Chemicals Economic Development Committee, was set up in 1971 to observe and analyse the operations of chemical companies in the UK, France, Germany and Holland, with special reference to industrial relations, manpower productivity and the relevant implications of UK membership of the European Economic Community; and to draw conclusions and make recommendations. 70p (80p)

Out of Sight, Out of Mind

The third report of a Working Party on sludge disposal in Liverpool Bay describes both the special and monitoring studies recommended in the first report. The emphasis has now moved from the spoil ground in the centre of Liverpool Bay to the beaches and inshore waters where social and amenity considerations predominate. £2 (£2.10)

Report of the Government Chemist 1972

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Society and the Assessment of Technology

This book, written by M. Francois Hetman of the Secretariat of the Institute for Economic Co-operation and Development, attempts to place the topic of technological assessment in its social and economic perspective, to define its scope and to outline the various methodological approaches it has evoked until now. £3.36 (£3.54)

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Cased £3.95 net Paper £1.95 net

object to the use of the term "tail" applied to the anterior flagellum of *Euglena*. Science and Decision Making describes industrial problems involved in the manufacture of PVC, polythene, oil and detergents as well as the social problems of living in high-rise flats or close to airports.

Patterns is both a relevant and an essential reappraisal of science teaching in the 1970's. *Ron Freethy*

Bacteriology

by John Humphries

John Murray, pp 88, £1.50

The bulk of this competent but uninspiring book is a rehash of cultural and other laboratory techniques in bacteriology, of the sort which could equally have been published 10 or even 20 years ago. The two remaining sections are brief, note-form guides to classification and such matters as bacterial growth, structure, and metabolism. These are so sketchy as to be inadequate. Metabolism merits a single page. Growth is considered without any reference to continuous culture, and R factors are not even mentioned.

The historic paraphernalia of bacteriology dominate the book. There is, for example, a photograph showing what happens to a plastic Petri dish that is accidentally autoclaved (it melts into a warped heap), but "the microscope" means the optical light microscope only. Though some electron micrographs are included, with totally inadequate captions, the electron microscope is not described or even mentioned in the text. Even such now conventional techniques as replica plating are missing.

Among other questions that occurred to me at first reading: Why do the pictures illustrating microscopy faults show plant cells, and not bacteria? For whom is the book intended? (Trainee medical laboratory technicians presumably, but there is no indication of this.) Who, for that matter, is the author? Why does he use a classification of bacteria based on a 17-year old edition of Bergey's "Manual" when the newest edition, which will doubtless reorganise the bacterial world once more, is due to be published next month? And why print such a scheme not once but twice, covering four pages of a short book that is apparently desperately short of space for more up-to-date information on other topics?

Bernard Dixon

Life on Earth

by Edward O. Wilson and others
*W. H. Freeman (Sinauer Associates),
pp 1054, £5.90*

This is the sort of book that will make many biology teachers reconsider the texts on their recommended reading lists. It is an introductory survey at about first-year university level and the authors' aim is to cover the whole range of biology. This is an ambitious project and presents a familiar dilemma. Biology is the study of life on Earth and

it is important to view the subject as a unity and to emphasise such topics as the *differentia* of life, the interrelation of living things, the origin and development of living things and so on. Biology, however, is also exceedingly diverse and draws deeply on the concepts and methods of physics, chemistry, mathematics and engineering as well as presenting a bewildering range of types of systems. Furthermore the sheer bulk of information in the biological sciences is daunting. In most textbooks the unified approach is safeguarded in that there is only one author; a uniformly high quality of balanced exposition is then very rare.

Life on Earth is a multi-author work, and each topic is described by an expert and overall unity has been achieved by professional editors. The coverage is comprehensive—from atoms to populations. Clarity of exposition has priority and was achieved wherever I read. Illustrations and diagrams are effective; photographs are limited in quality but adequate. The difficult task of illustrating three-dimensional molecular structures is beautifully solved.

The main feature of this book is that it accurately conveys the content and the tone of the agreed corpus of current biological knowledge. It is a highly professional job and must be one of the best one-volume surveys of modern biology. One sacrifice in the effort to obtain both a comprehensive and lucid text is description of actually *how* the knowledge is obtained. There is little emphasis on technique though this is essential to both practical and theoretical appreciation of scientific results. Furthermore, the confident style does not readily lead to critical assessment of the present picture. It is arguable that a liberal arts student misses at least half the point of science if he is only presented with the results and given little indication of the spirit and the methods of scientists. Despite all this, the book deserves to be widely used. *Andrew Miller*

Understanding human behaviour

by James McConnell

*Holt, Rinehart and Winston,
pp 832, £5.75*

Once upon a million times a psychology student walked into a bookshop, selected one of the 50 or so different introductory psycho texts displayed on the shelves, paid for it, took it home, read it . . . and was bored. So, along comes fairy godmother James McConnell and conjured up an entirely new kind of book. (And with the bookshelves already groaning under the considerable weight of the half century or so of existing texts, any potential author must have a very good reason for pushing the number towards the ton. McConnell has.)

As a professor of psychology at the University of Michigan, McConnell obviously has close contacts with students—the potential consumers of his book. McConnell clearly realises that most texts are written for students, with very little true appreciation of what students really



Longman
1724-1974

want. "Understanding human behaviour" is supposed to be what the students want, because over a period of several years McConnell consulted closely with his students, asked them how best they liked to assimilate information, and moulded his text—all 832 pages of it—to their demands. The outcome was very well worth the considerable effort.

As an introductory text McConnell's book encompasses everything between neurones and human emotion. Indeed, one of the main features of the book is that it places the whole topic of psychology within a very definite human context—hence the title of the book. The areas covered include the neurological basis of behaviour, sensation and perception, motivation, learning and memory, development, personality and social psychology—truly a comprehensive text. Probably more than any other similar book on the market, McConnell's gives lucid accounts of the mechanics of the multifarious facets of psychology, together with a feeling for real human involvement.

The sense of human involvement is created first by the carefully judged style of writing, but more spectacularly by the small slice of relevant fiction that precedes, and highlights, every chapter. How better to make an academic subject come alive? When they were monitoring the progress of the book in its embryonic stage, the students claimed to like the fiction most of all. It certainly made them enthusiastic about the book, just as I am.

Roger Lewin

Collins guide to animal tracks and signs

Prehen Bang and Preben Dahlstrom
Collins, pp 240, £2.95

'Mrs Mary Whitehouse would not like this book. According to a recent report in The Times, she considers that "overexplicit visual presentation of violence, including that of accidents, feeds the sick mind and tends to normalise such violence even in the minds of ordinary people". In her view, it should be possible to report a killing or a road accident without showing blood on the road and agonised faces of the victims.

How the National Viewers' and Listeners' Association would cope with nature red in tooth and claw I do not know, but I doubt if they would approve of the Collins' approach. Listen to this caption of a photograph—itsself printed in unnecessarily explicit Technicolor. "Hare killed by crows which have eaten part of the hind-quarters. Although crows can easily kill leverets, they can only overpower the adults when these are old, weak or sick. The hare shown here had had its eyes pecked out while still alive. The front paws became smeared with blood as the animal rubbed its eye sockets". Fodder for sick corvine minds? The normalisation of unnatural violence? Little Grey Rabbit was never thus.

This well-illustrated book is, according to its somewhat mendacious subtitle, "a guide to the tracking of all British and European mammals and birds". Text, diagram and photograph are skilfully

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New Books from Blackwell

Chemical Analysis of Ecological Materials

Edited by Stewart Allen, Max Grimshaw, John Parkinson and Christopher Qarnby. August 1974. 352 pages, 60 illustrations. About £8-00

Lecture Notes on Invertebrate Zoology

M. S. Laverack B.Sc. Ph.D. F.LINOL. F.R.E.S. and J. Dando B.Sc. M.Sc. July 1974. 352 pages, 260 illustrations. Paper, about £4-50

The Effects of Meteorological Factors upon Parasites

Symposia of the British Society for Parasitology, Volume 12, edited by Angela E. R. Taylor and R. Muller. 1974. 128 pages, 13 illustrations. Paper, £3-50

Algal Physiology and Biochemistry

Botanical Monographs, Volume 10, edited by W. D. P. Stewart Ph.D. D.Sc. August 1974. 960 pages, 75 illustrations. £15-50

The Structure of Marine Ecosystems

John H. Steele. 1974. 128 pages, 45 illustrations. £2-75

The Biochemistry of Cytodifferentiation

D. E. S. Truman B.A. Ph.D. 1974. 128 pages, 51 illustrations. Cloth £3-50, paper £2-00

Membranes and their Cellular Function

J. B. Finean D.Sc., R. Coleman Ph.D. and R. H. Michell Ph.D. August 1974. 160 pages, 200 illustrations. Paper, about £3-75

The Biology of Brains

Edited by W. B. Broughton. 1974. 336 pages, 40 illustrations. £6-50

A Manual on Methods for Measuring Primary Production in Aquatic Environments

IBP Handbook No. 12, edited by Richard A. Vollenweider. Second Edition, May 1974. 224 pages, 24 illustrations. Paper, £3-00

Methods for Ecological Bioenergetics

IBP Handbook No. 24, edited by W. Gorzinski, R. K. Klekowski and A. Duncan. August 1974. 356 pages, 96 illustrations. Paper, about £7-00

Persistent Pesticides in the Environment

C. E. Edwards M.Sc. M.S. Ph.D. Second Edition. May 1974. 208 pages, 100 illustrations. CRC Press, about £13-00

mixed, so that we can see both what a footprint ought to look like, and what it really resembles in mud or snow. Domestic mammals are sensibly included, so that one can distinguish between dog and fox, deer and cow, wild goat and sheep. As well as footprints, there are excellent sections on the different ways various mammals and birds attack hazel nuts, the signs deer leave while nibbling trees, and the beak marks left by waders in sand. There are also sections on droppings, urine, and pellets, adding up to the best general book on the subject yet published.

For all that, the publishers cannot be commended for the way in which they have simply translated a Danish book without (so far as I could see) any attempt either to adapt it for the British market or to point out that they have failed so to do. Indigenous British species get no mention, so that we are, for example, given no details of the tracks of the Orkney vole or the white-toothed shrew. Again, while the European mink (which occurs in Scandinavia) is described, the American mink (which is the species found in Britain) is omitted. Similarly, the (British) water deer is not included, while the (Danish) white-tailed deer is present. One of the most serious omissions is the coypu: naturalised in East Anglia but not on the continent.

The book makes no attempt to indicate the distribution of the animals it describes, even though this information is available in companion Collins field guides, whose small maps could easily have been incorporated in this volume. For example, the excellent photographs of damage done to trees by the great black woodpecker would have benefited greatly if we were told that this species is confined to the coniferous forests of northern mainland Europe. There are some signs of hasty editing, as when a picture of an unidentified drey is indexed under both red and grey squirrel. Moreover, the usefulness of the plates is limited by a maddening failure to number them. The slapdash way in which this book has been produced, as a largely unedited translation of a Danish text, argues a contempt for the buying public which one would not have expected from the outstanding record built up by Collins in their previous field guides in this series.

Jon Tinker

The rats

by James Herbert
New English Library, pp 174, £1-95

This novel is about rats; giant black rats which eat people. During the course of the novel, they eat a lot of people, gorging themselves on the tender parts, and generally being thoroughly nasty, because, even if the victims do escape with some shred of flesh still left on them, they die within 24 hours, from an unpleasant disease.

Initially, the rats eat people individually, or in small groups. Then they discover a novel form of canned food: tube trains, fresh-packed on a Monday morning with assorted commuters. Even better, although they don't actually get

at them, are schools full of yummy little children.

Faced with these nasty mutants, the human race—or that part of it that runs London, where the rats break out—falls back on its natural stupidity to make matters worse. A virus, unbelievably made ready in a week, is launched upon the rats. This has the capacity to kill all animal life (except humans, and wanted animals, which have been injected with an antidote); however, it does not kill all the rats. Another method eventually does that; or would have done, but for some inevitable human greed gumming up the works.

What worried me, apart from the glibly produced virus (novellists who do not grasp technicalities ought not to try to be technical; the vaguer one is, the less chance of being caught out, and the more one leaves for the reader's warped imagination to embroider for himself—which can add immeasurably to a story), was how stupid the humans were permitted to be. For example, when attacking the rats (with water hoses of gas), none of the attackers seemed to take the simple precaution of carrying a loaded gun with him.

Nitpicking apart; The Rats is an enjoyable fast read. Try reciting it aloud to your travelling companions next time your tube train gets stuck in a tunnel. . .

Martin Sherwood

The past decade in particle theory

edited by E. C. G. Sudarshan and Y. Ne'eman
Gordon and Breach, pp 820, £14-55

Particles, sources and fields Volume 2

by Julian Schwinger
Addison Wesley, pp 460, npp

The 1960's were years which saw a substantial shift of emphasis in particle physics. Although the decade ended with no more of a comprehensive theory than when it began, it did bring a measure of order to the complexity of hadronic interactions. The very different theoretical ideas of complex angular momentum analysis on one hand, and unitary symmetry and current algebra on the other, between them afford a successful framework for phenomenology and deep and provocative insights into dynamical behaviour. To be sure, these advances have thrown up new problems too: not many of the questions posed in 1960 had been answered by 1970, and then a lot of new ones were added to the list. Early in 1970 a symposium on "The Past Decade in Particle Theory" was held in Austin, Texas, and these proceedings still make useful reading, surprisingly few of the articles having become seriously outdated since then. Of course the roster of unsolved problems has grown still further, and a similar set of 20 survey lectures today would omit some of the topics covered here, not because the problems posed have been solved but rather that they have been stranded, by-passed as the thrust of present research has opened up new areas and left them for some "mopping-up" operation at some inde-

finite time in the future.

A number of the papers are particularly good reviews, consolidating what was then the "state-of-the-art": Loyal Durand's paper on high-energy scattering phenomenology for example, while obviously needing to be up-dated to cover also the later experimental data, is still very serviceable, as is N.P. Samios's survey of particle spectroscopy. Stanley Mandelstam's article on dispersion theory and Richard Feynman's on partons are both full of illuminating and penetrating ideas. It is interesting to see, with the benefit of hindsight, which topics appear by current standards to have been under-emphasised; these would surely include the dual models for hadronic resonances, the light-cone algebra approach to scaling and sum-rules, and the advances in renormalised perturbation techniques in field theory, to pick a few at random.

For those who enjoy Julian Schwinger's very characteristic approach to relativistic field theory, the publication of the second volume of the three which will make up his text-book on *Particles, Sources and Fields* will have been anticipated with interest. It is devoted entirely to electrodynamics and is unusually rich in detailed calculation. However, it is by no means self-contained and only makes sense in conjunction with the earlier volume. Schwinger's approach is not without its critics: here one can see something of its strength, but I'm not sure that many will be tempted to do their own work using these techniques however dazzling is Schwinger's own mastery of "sourcery". John Charap

The primary structure of transfer RNA

by T. V. Venkster

Translated from Russian by Basil Haigh
Plenum Press, pp 296, \$29.00

It is extremely difficult to imagine the potential readership of T. Venkster's book. It is obviously a major problem for a translated work of this type to remain topical and up-to-date, but already this book is virtually only of historical interest.

The literature survey extends until early 1971. For this reason only 22 complete sequences are reported whereas more than 60 are now published. A current compendium of all sequences known by Barrell and Clark is to be published soon by Joynton-Bravver, Oxford (The Handbook of Transfer RNA Sequences) and this will be regularly updated. The main part of the book is taken up with a detailed survey of the precise strategy and tactics employed in the determination of the sequences of the first five transfer RNA molecules, together with a less thorough account of the later ones to be determined. The writer succeeds in capturing some of the excitement of the era by evaluating in detail the various ways the overlapping problem was solved in each individual case.

The chapter on the techniques used to determine nucleic acid sequences is rather weighted towards the conventional non-radioactive approach. Even of the few sequences quoted, half were determined by Sanger's radioactive fingerprinting methods and more than half the

sequences known today were obtained by these techniques. Once again there are many other publications—books, reviews and monographs—which cover sequencing techniques much more fully. The discussion of the minor components of the different transfer RNA molecules is more satisfying. It is fairly comprehensive in terms of the physico-chemical properties although a little more on their biosynthesis would be welcome.

The book is an extended and revised version of an original Russian monograph published in 1968. Unfortunately the translation is rather clumsy and much of the prose difficult to read, whereas the original was both vivacious and topical. Furthermore, to pay for the double work load involved, this book is at a quite unrealistic price. For \$29.00 one can purchase other books containing not only this information but much more besides and still have money in hand for 1 milligram of [³²P] or an excellent meal.

Chris Bruton

The feldspars

edited by W. S. MacKenzie and J. Zussman
Manchester University Press,
pp 718, £9.00

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terms of geological history. This book contains a selection of papers given at the second NATO Advanced Study Institute on Feldspars held at Manchester in 1972, and illustrates strikingly the range of viewpoints and techniques of study that have been brought to bear on the feldspar group.

Three papers are reviews; 29 present original material but include more background information than is usual in research publications. The Feldspars will therefore be a useful book for those who wish to bring themselves up-to-date on developments in the field, and 800 references, conveniently collected at the end, will be invaluable. The papers are arranged in four sections, beginning with structure. The long-standing problem of locating aluminium and silicon directly in the feldspar structure using X-ray diffraction has been resolved using neutron diffraction. Part two deals with phase equilibrium and thermochemistry. One may doubt whether the breaks which appear in "analytically smoothed" alkali feldspar solvus curves will survive rigorous experiment, but two short papers describing the hydrothermal growth of large synthetic feldspars may begin to bridge the gap between experimental products and natural examples. A third section deals with electron microscopy, which with the advent of ion-beam thinning has revealed an astonishing array of fine structures, particularly in plagioclases. The origin of many structures remains obscure, but the shadowy images produced by the electron microscopists are reproduced well. Finally, minor element substitution and a few natural occurrences are described with very little on igneous rocks. The feldspars may well be a storehouse of information concerning the geological history of rocks, but a great many features remain of uncertain interpretation.

Ian Parsons

Recent advances in dynamical astronomy

edited by B. D. Tapley and V. Szebebelly
D. Reidel, pp 468, 135 Swiss Fr.

The classical subject of celestial mechanics was probably rescued from extinction by the recent arrival of computers, space travel and the radar/laser beam. This book contains lectures delivered at the 1972 Cortina summer school and covers a wide range of topics at a fairly high level. Although the emphasis is on current work, some of the articles also serve as useful introductions. Among the latter, there is a thorough discussion of the fundamental units, coordinates and time-scales which provide the framework for nearly all modern astronomy. We now live in the age of the nano-second where predictions of dynamical theories cannot match the observational accuracy. However, the history of planetary motions illustrates well the process of improvement which goes on.

By employing computers as their slaves, the new breed of dynamical astronomers perform the equivalent task of building pyramids single-handed. Although many establishments are still

living in the numerical stone age, the brute force method of solution is yielding to the powerful regularisation technique which is based on the idea of stabilising the equations of motion. Recent developments have been influenced by Professor E. Stiefel, whose introductory lectures are included. Such ideas will be required if one is to achieve a reliable Solar-system integration beyond a few million years. On the fundamental three-body problem, there is a noteworthy contribution by Professor V. Szebebelly in which the inevitability of escape from most bound systems is confirmed by elementary analysis. However, even after yielding its main secret, this celebrated problem will undoubtedly continue to be cultivated for its own sake.

It is refreshing to note that a deterministic subject does have its controversy, which here takes the form of a previous massive planet in the asteroid belt to account for slight discrepancies in Bode's law. On the whole, Recent Advances in Dynamical Astronomy confirms the view that the subject is alive and prospering. Although expensive, the presentation is excellent and the editors deserve credit for the idea of including a selection of research papers by the participating students. Sverre Aarseth

Exhibition

Guglielmo Marconi 1874-1937
Science Museum, London, for about
six months

If you have the time to spend reading, rather than simply looking, the centenary exhibition of Marconi at South Kensington is rewarding. If you simply want to see historical apparatus and so on, you may be a little disappointed, for the level of literary "noise" is rather high there. However, the splendid kite that carried aloft the aerial for the famous trans-Atlantic communication is on show. So are quite a few technical bits and pieces such as Marconi's "cocothers"—the primitive detectors which preceded Fleming's valve (also included).

Many photos show off Marconi's solemn demeanour; the pioneering atmosphere of himself and his colleagues comes over well; and many accolades emblazon the show cases apart from the extensive correspondence surrounding this Irish-Italian's spectacular achievement. Marconi formally dressed for the Coronation in full regalia (also there, complete with rapier—and more everyday swordstick) is a treat. If you pursue the documentation, don't miss the enchanting Punch interview, written in that magazine's heyday.

I felt that the exhibition, otherwise excellent, could have done with a little more shaping. I could not, for instance, straight away find the point at which Marconi's trans-Atlantic success echoed round the world. Another rather sad omission was apparently no mention, photo, or whisper of the man who really began it all. Hertz features briefly, of course. But shouldn't a very small corner have gone also to James Clerk Maxwell?

Peter Stubbs

The reception of Copernicus' heliocentric theory

edited by Jerzy Dohrzkycki
D. Reidel, pp 368, £1.65

Copernicus was a child of his time, a product of the Renaissance, a man influenced by the recovery of classical culture and Greek science. Yet if the new cosmology he forged was in a way no more than a resurrection of ancient ideas, it contained within itself the seeds of a complete re-orientation of outlook on the natural world. Presented with full mathematical detail, its effect was to be epoch-making but, of course, this took time: a revolution in thought does not come overnight. With this in mind in Torin last year, the 500th anniversary of Copernicus' birth, the International Union for the History and Philosophy of Science held a symposium on the acceptance of the hypothesis. The Reception of Copernicus' Heliocentric Theory is one of the results.

Opening with an admirable hors d'oeuvre by Robert Westman on Mastlin and his influence on Kepler, a key figure in the promotion of the heliocentric outlook, there are essays by Kristian Moesgaard on the theory's reception in Denmark and Norway, Henrik Sandhland on its arrival in Sweden, Jolan Zemplen on Hungary, Juan Vernet describes Spanish opinion, and Shigeru Nukayama portrays what happened in Japan. But, regrettably, the Chinese are virtually

omitted and the stormy Italian scene is not even sketched. Yet the editor, Jerzy Dohrzkycki, would probably retort that what the IUHPS Committee wanted was new insights, and this in fact, is what the book provides. Perhaps, then, the title ought to reflect this.

Among the more unusual essays is one (in German) by Hans Blumberg suggesting that Newton's concepts of absolute time and space were consequences of Copernicanism, one by Harry Wolf on the early American reception, throwing interesting light on science in a strictly Puritan community and, perhaps the most novel, by Barbara Bienkowska, who describes Copernicanism in Polish school education. This essay contrasts the adaptation to new ideas of Protestants and Catholics, as well as the changing scientific viability of heliocentric ideas.

For to begin with, Copernicanism was scientifically suspect, although considered a gem of astronomical computation: Moesgaard's second essay makes this clear, even if the English Copernicans, whom John Russell's paper delineates so well, were bold enough to see below the surface and so be among the very first to accept the new hypothesis.

As a book, The Reception of Copernicus' Heliocentric Theory is a little patchy; the few illustrations are subfusc; the English not always perfect, and the inspiration varies. But even with a substantial price, it remains a useful contribution to the history of science.

Colin Ronan

Tapes

Oil: a world crisis

Seminar cassettes, London, £2-50

Who will pay £2-50 for a 28 minute pre-recorded cassette of four men telling you about their analysis of the world oil crisis? You have to ask this question before you can begin to review sensibly such a tape. Schools are one possibility, and for them this "anthology" of four men talking about oil at a very elementary level might make good classroom material.

The four men are Granville Watts, William Scally (both Reuter correspondents), Bart Collins (editor of Petroleum Times), and Dan Ions (chairman of the scientific programme committee for the World Petroleum Congress). I almost stopped listening when told, for what seems to me like the millionth time, that the US has 6 per cent of the world's population and consumes around a third of the world's energy. My pain at hearing yet again this slovenly way out of doing some research was slightly alleviated when the second side of the tape told me that the US accounts for 7 per cent of the world's population.

For schools the fairly superficial level of the programme may be satisfactory. But if you are someone wanting to keep up-to-date on the oil situation, forget it! Ten minutes with a good newspaper article would be more revealing. I judge the use of an article or tape by the number of times I stop to take notes.

I did this twice during this tape, when Dan Ions gave his thoughts: "There is no world energy crisis. There is no world petroleum crisis, as yet. There could be, if the normal reactions of supply and demand are distorted." (I leave you to argue that one out.) And later when he told us: "The interdependence of all energy forms will become increasingly obvious and also practical. And better science and technology will overcome the mistakes of poor science and technology." It is nice to know that someone still believes in the "technical fix" when many technocrats have lost faith in the power of their methods.

Perhaps there is a customer for tapes such as this. It is just the sort of thing that the hard-up London Broadcasting Company (LBC) might put out when one of its phone-ins shows signs of flagging. Could it be that Seminar Cassettes has its eye on the multitude of commercial radio stations that are about to be sprung upon us? The cost of the tape is, now I come to think of it, not far from the fee you can extort from LBC after doing a 30 minute programme.

Michael Kenward



Almost All About Waves

John R. Pierce

In this book, the author once again brings a diffuse and difficult field within reach of non-specialized readers. The study presents waves in all their manifestations and realizations (a subject that perfectly joins basic science and everyday reality), an almost unlimited array of specific phenomena, ranging from earthquakes and sound waves to the predictive waves used in quantum mechanics.

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Understanding Scientific Literature

A Bibliometric Approach

Joseph Donohue

This work was written from the conviction that if the flood of new publications in the sciences is to be effectively channelled, from both the user's and librarian's point of view, it is necessary to describe more exactly how vital information is distributed within available subject literature and to measure the comparative merits of various sources.

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The Neurosciences

Third Study Programme

Francis O. Schmitt and
Frederic G. Worden,
Editors-in-Chief

The Neurosciences: Third Study Programme covers twelve topics that have been selected as especially significant and catalytic trends in neuroscience research. These range across the various levels of organization of the nervous system—molecular, cellular and behavioural.

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Ordinary Differential Equations

V.I. Arnold

Translated from the Russian by
Richard A. Silverman

Although there is no lack of other books on this subject, the appearance of this new one is justified on at least two grounds: its approach makes full use of modern mathematical concepts and terminology of considerable sophistication and abstraction; the resulting enhancement of mathematical abstractness is balanced by a constant appeal to geometrical and physical considerations.

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Magnetic and Electric Suspension

Richard H. Frazier,
Philip J. Gillinson, Jr.,
George A. Overbeck

The success of the Apollo moon flight programme depended in no small part on the reliability of the inertial sensors in the navigational and guidance systems. The authors played a major role in the development of these devices at M.I.T. and their book describes and analyses the operating characteristics of both active and passive types of magnetic and electric suspensions.

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Letters

High energy physics

Sir,—I was pleased to read Dr Stubbs's plea for research in high energy physics (Comment, 18 April, p 107). He is quite correct in drawing attention to the exciting new results coming from experiments done using the electron positron storage rings at Cambridge, Massachusetts, and Stanford. These show that at the highest energies now available (5 GeV), when these two particles annihilate, they convert into large numbers of mesons with a probability an order of magnitude higher than that expected on the basis of current ideas on partons. This fascinating process in which a system consisting almost exclusively of kinetic energy is transformed into sub-nuclear matter, presents an exciting challenge at a very fundamental point in the theory of nuclear forces and super high energy densities.

I am glad to say, however, that the Science Research Council's plans in this connection are not as bleak as Dr Stubbs implies. A major project being seriously considered is the construction of an electron positron proton intersecting complex (EPIC) which was, in fact, briefly but accurately reported in *New Scientist* (Technology Review, vol 61, p 261). Stage I of this, which is being proposed as a national project to follow Nimrod and Nina in the early 1980s, is for the construction of storage rings in which electrons and positrons would clash head-on at a total centre of mass energy of 28 GeV. This would, of course, be directly relevant to the exciting developments mentioned above and would hopefully give the UK a world lead in this field. Stage II, consisting of the addition of a proton ring at either 80 or 200 GeV, would extend the project to the study of collisions of electrons and positrons with protons at energies far beyond those available at present. This major extension could only be done on some basis of international collaboration.

In view of some of Dr Stubbs's other remarks, I should add that the Daresbury Laboratory 5-GeV electron accelerator, Nina, is not due to close until 1977 at the earliest. This is generally recognised as substantially before it becomes obsolete, but its premature closure was the price which the high energy physics community in the UK agreed to pay in order for the UK to take part in the construction of the 300 GeV proton accelerator now in progress at CERN. Sir Brian Flowers, as chairman of SRC at the time, can take much of the credit for this arrangement, which involves the reversal of an earlier government decision, and the high energy community is grateful to him for the part he played in bringing it about.

P. T. Matthews

Department of Physics
Imperial College of Science and
Technology
London SW7

Scientists' salaries

Sir,—Your correspondent J. Wilson (Letters, 14 March, p 712) rightly points out that salaries of academic staff of polytechnics are considerably below those in universities. This makes the stated government aim of equal status a little difficult to achieve. A similar difficulty exists over the proposed policies for research and postgraduate teaching at polytechnics. A recent report of a Study Group of the British Association (73/1) recommends that in polytechnics such activities should be restricted to "group consultancy work in the field—under the constraints of industry or government". The absurdity of this type of limitation is brought home by the statement of the secretary of the British Association, Dr Magnus Pyke (In Person, 11 February, p 597) that it was to the credit of students that they were repulsed by a purely economic approach to the applications of science.

A glimmer of enlightenment comes from the Third Report from the Expenditure Committee of the House of Commons published in December 1973. They studied evidence from 29 sources concerned with postgraduate research in universities and polytechnics and concluded that a government policy statement on polytechnic research was "a little masterpiece of opacity"—"no artificial limitations should hamper the right and the need of polytechnics to provide postgraduate research facilities"—"We think the universities should compete with the polytechnics on equal terms seeking for themselves those areas in which they can excel."

Are not the government policies to polytechnics a hang up from their 19th century ancestry for teaching the working classes how to hash bits of metal together?

W. O. George

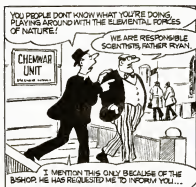
91 Ashcombe Road
Dorking
Surrey RH4 1LW

Peddling the drugs

Sir,—Your comment referring to my remarks on Pharmaceutical research expenditure (18 April, p 107) states once again the fact that the industry spends more on sales promotion than on research, with the questionable implication that there is something self-evidently wrong about that. On the other hand, the discovery of new medicines and the process of introducing and explaining them to doctors are in fact both necessary and inter-related steps in the total process of pharmaceutical innovation.

The pharmaceutical sector is exceptional among British industry in its success in innovation and this success depends not only on good research but also on getting the fruits of this research into use. How much of the present sums spent to this end could be "saved" without seriously slowing down the rate of

Grimbledon Down



Bill Tidy

introduction of new medicines is an imponderable. The practice question is how in reality regulations or further self-restraint could be applied in the industry to effect an overall reduction in the level of sales promotion without at the same time blunting its competitive edge which the Sainsbury Committee, among others, recognised as a valuable stimulus to pharmaceutical innovation.

The industry would, I am sure, welcome constructive suggestions on this issue; however, it is likely to be disappointed by destructive criticisms of its level of promotion expenditure merely based on an irrelevant comparison with its level of research expenditure.

George Teeling-Smith
Office of Health Economics
162 Regent Street
London W1R 6DD

I am delighted that Mr Teeling-Smith at least considers the possibility not only of regulations, but also of self-restraint, over pharmaceutical sales promotion. Indeed, he welcomes practical suggestions to this end. That is welcome progress. We agree too that greater expenditure on promotion than research (judged by simple numerical comparison) is not self-evidently wrong. It is clearly so, however, when one considers the grossly misleading nature of much drug advertising (one example of which I quoted), its lavishness, and its prolific use to peddle products which are not the fruits of genuine innovation but unnecessary rehashes whose only originality is in their packing. Editor

to the principles of the present Act, they think that in practice this is for individual consciences (eased by fat fees for doctors in the private sector, no doubt) to decide, and not for the law: they certainly don't propose (Section G, pp 64-67) any effective ways of dealing with these admitted abuses of the law.

In these circumstances it is rather remarkable that the Committee could have been "unanimous in supporting the Act and its provisions" (para 605), while agreeing that its provisions were being flouted so far as abortion on request is concerned. In this they are far from being representative of public opinion: Table 3-2 (volume II, p 30) shows that in 1971 among the general public only 20 per cent of men and 15 per cent of women were in favour of abortion on demand, and that 44 per cent in 1972 (increased from 38 per cent in 1970) wished to see the law changed to make it harder to get an abortion.

C. B. Goodhart
Society for the Protection
of Unborn Children
Cambridge

Nuclear insights

Sir,—It was indeed exciting to read about the development of the holographic electron microscope (Monitor, 18 April, p 108). Using this technique, if its claims are substantiated, it will be possible to represent visually the inhomogeneities in the atom, i.e. the different spatial

distributions of the constituents, the electrons and the protons.

This leads one to wonder whether the same technique could not be applied with higher energy protons to visualise the inhomogeneous structure of the nucleus. The much shorter wavelength of the proton beam should help produce holograms with finer resolution. In the case of the holographic electron microscope, part of the electron beam scatters elastically with the specimen and then interferes with the reference beam. By ensuring that the energy of the proton beam is below the inelastic threshold, one could duplicate the conditions prevalent in the electron microscope.

Also, rather than forming a hologram on film, counters could be set up a large distance away from the target and the output from these could later be used to construct the hologram using a computer.

Monochromatic proton beams will of course be needed. Nuclear as well as nucleonic structure could be "seen". The method suggested is almost identical to what is currently done in counter and bubble chamber experiments except that interference between the scattered and reference beams is not utilised in such experiments at present.

Maybe one day we might even see the protons that make up a nucleon, if they exist!

R. Raja
Trinity College
Cambridge CB2 1TQ

Abortion law reform

Sir,—As Mrs Madeleine Simms, of the Abortion Law Reform Association, quite rightly points out (Comment, 11 April, p 59), the Lane Committee has recommended, with no minority report or reservations, that nothing of any significance needs to be done to reform the present law and practice of abortion and that "the decks have now been cleared for the final stage of the abortion campaign—abortion at the request of the client before 12 weeks' gestation", taking no regard for the child.

That of course wasn't the view of the Lane Committee themselves—"... we should have recommended against abortion solely at the request of the woman even if the matter had been fully open to us" (volume I, para 189) and "the operation to abort a fetus violates the sanctity of life... and... presents both patient and doctor with a dilemma which challenges in a most acute and often agonising form the individual consciences of both" (para 606). But although they recognise that in any event "in some parts of the commercial private sector the provisions of the Act have been flouted and abortion on request has been the rule" (para 603), they feel that "an individual decision it must however remain" (para 606). This can mean only that although the Committee themselves don't much like the idea of abortion on request, and recognise that it is contrary

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Electronic feudalism

Sir,—One of the most important statements in Mr Peter Laurie's arguments is that inflation is the natural defence against over investment ("Capital and electronic feudalism", (14 March, p 676). It is important since it offers a clue to the way out of our present economic difficulties. If Mr Laurie's arguments are correct, then the greatest danger facing this country is that by some mischance the politicians might succeed in stopping inflation.

Indeed have the politicians ever provided any justification for the "fight against inflation"? I know for instance they talk about people living on small fixed incomes, but who are these people? Why are they so important to the nation, that the whole well-being of the nation must be put at risk to defend them? Could they not be helped in other ways?

As an ordinary professional I find continuing inflation a positive help. As wages and prices continue to rise, my mortgage repayments become less and less as a proportion of my total income. Inflation is destroying my debt to the building society.

Of course an economy without inflation would be desirable if it could be achieved without unemployment and distress to millions of people. If the interest rates were forced down world wide by legal means, then we could look forward to a reduction in the natural rate of inflation after the effective national debt had been reduced by inflation to a bearable level.

These ideas may seem so novel and revolutionary that the politicians and economists may be inclined to dismiss them out of hand. However, I think we may point out that their record in the practical world can hardly be called a success. No government has succeeded in its economic aims since the war. Indeed success, as measured by a rising standard of living, has only been achieved when inflation has been allowed to rip.

Derek V. Moreton

15 Church Road
Alsager
Stoke-on-Trent

Sir,—Peter Laurie starts his argument with "time=money", an equation which may satisfy the wage-pocket economist, but which raises the backles of a functional purist, like myself.

Time is simply something necessary to accomplish change, or evolution. At the fundamental level, "time" results from the fact that the transmission of energy through space is not instantaneous.

Money is a means of exchange, and/or the thing which makes the wheels of industry go round. On both counts, its most direct analogue in the physical world is energy.

Once "energy=money" is used as the basis for speculation, the future begins to look much rosier than Peter Laurie's conflict-ridden scenario and, indeed, far less speculative, for the possibilities of playing about with "energy" are fairly strictly governed, by the well-known laws

of conservation.

A far more stable and humane concept of value is introduced, in which human energy once more becomes an efficient "productive resource", and the human mind will at last have the sense to recognise its potential, as a far more efficient manager of resources, than all those simple idiot MOSFETs.

Joan M. Pick

25 Maybourne Grange
Turpinke Link
Croydon CRO 5NH

Hot shot

Sir,—In line with your recent correspondence concerning the spontaneous heating of iron cannon and shot after long immersion in the sea, the Conservation of Antiquities and Works of Art, by H. J. Plenderleith (2nd ed, London 1971, p 286), refers to the cleaning of ancient iron objects by means of electrolytic reduction. The relevant passage runs:

"As a matter of interest, electrolytically reduced iron often steams when first rinsed after removal from the tank. This is due to the rapid oxidation of pyrophoric iron, and a case is on record where a large piece of black reduced rust, when picked off, actually glowed and burned through the french polish on the bench!"

Jack M. Ogden

40 Southfields Road
London SW18 1QJ

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required for laboratory preparing from human blood plasma materials for the treatment of patients suffering from bleeding disorders. This is an additional appointment, owing to expansion of work, chiefly in connection with quality control including chemical and biochemical tests and assays. The successful applicant would be expected to take part in other work of the laboratory.

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Applicants with suitable academic qualifications but lacking laboratory experience will be considered for appointment in the first instance to the Junior Technician grade, with prospect of early promotion if proved satisfactory.

Write for application form to The Secretary, Plasma Fractionation Laboratory, Haddam, Dept., phila Centre, Churchill Hospital, Oxford OX3 7LJ.



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Royal Australian Naval College

Director of Studies

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Director of Studies, Royal Australian Naval College

- | | | | |
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| Salary: | \$A13390-\$A14328 per annum (an additional \$A500 per annum special allowance is also payable). | Senior Entry: | Aged 17-19 who have matriculated prior to entry. After matriculation, the two entries are combined, with approximately half reading for degrees whilst the remainder undertakes the Creswell Course of approximately 1 year and 6 months duration. |
| Qualifications: | Honours degree, higher degree or equivalent qualifications together with broad administrative experience in responsible positions in educational institutions such as Teachers Colleges, Technical Colleges or Senior Schools. | Accommodation: | A residence will be available on a rental basis for a married appointee. A single appointee can be accommodated in the wardroom mess. |
| Duties: | Overall direction, administration and supervision of all academic studies undertaken by junior officers under training at the college; Organisation and supervision of teaching; Preparation, planning and development of academic courses; Control the studies programme including direction of first year university studies in B.E. (Mech), B.E. (Elect), B.Sc. and B. Surv. undertaken at the college (subsequent years are undertaken at the University of New South Wales). | Commencement: | The successful applicant will be required to take up duty at the beginning of the 1975 academic year on 28th January 1975. |
| | | Vacations: | The College has a long vacation at Christmas and two shorter vacations between terms. |
| | | Note: | The position is permanent and to be eligible for appointment applicants must be British subjects with permanent residence status or be Australian citizens. The appointee will be required to contribute to the Commonwealth Superannuation Fund. |
| Location: | The Royal Australian Naval College is situated on the shores of Jervis Bay, Australian Capital Territory some 100 miles south of Sydney. | Applications: | Application should be made to the Australian Naval Representative, UK, Australia House, The Strand, London WC2 by 27th May 1974 together with curriculum vitae. Full details of appointment conditions will be available on request from the above address. |
| Cadets join the College through either Junior Entry: | Aged 15 or 16 and spend two years in preparation for the NSW Higher School Certificate leading to matriculation. | | |

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UNIVERSITY OF NEW SOUTH WALES Wellington University College, to become the University of Wellington 1st January, 1975. LECTURER—DEPARTMENT OF PHYSICS

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Write or telephone for application form to Miss S. M. Hurley, Imperial Cancer Research Fund, Lincoln's Inn Fields, W.C.2. on 242 0200 ext. 305.

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Please contact by letter or by a reversed charge telephone call:

C. M. Whitney, Personnel Manager, Searle Laboratories, Whalton Road, Morpeth, Northumberland. Tel: Morpeth 411.

SEARLE

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The department is closely linked with The Welsh National School of Medicine and carries out service work and research. It occupies new accommodation and has recently been equipped with a complete range of service and research equipment.

Holder of the posts will be expected to register as postgraduate students with The Welsh National School of Medicine and undertake research work with a view to obtaining the Ph.D degree. They will also be expected as part of their training to study for the Mastership in Clinical Biochemistry.

Salaries and conditions of service will be those prescribed for Biochemists by the Whitley Council.

Further particulars and an appointment to visit the department may be obtained by writing to Professor C. N. Hales at the Department.

Application forms may be obtained from the Divisional Administrator, University Hospital of Wales, Heath Park, Cardiff.

Scientific posts in Diamond research



The De Beers Diamond Research Centre at Johannesburg is the largest diamond research establishment in the world. The wide field of research and development includes the scientific and technical investigation into problems related to industrial diamond and its application in industry. Also the promotion of the more efficient use of diamond in existing applications and the development of potential new applications.

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Initially please apply to H. W. Cooke, Personnel Manager, Research and Development Division, G. D. Searle & Co. Ltd.,

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Bucks. Telephone number 21124
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Reference OC/103.

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Please write quoting reference AQ.450 giving brief details of qualifications and experience to the

Senior Personnel Officer
The Wellcome Research Laboratories
Langley Court, Beckenham
Kent BR3 3BS



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VIRAL PRODUCTS DIVISION

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Junior Technician

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Please write or telephone Warrington 65000, Ext. 467, for an application form, quoting reference DL397/S to:

Personnel Officer,
Science Research Council
Daresbury Laboratory,
Daresbury,
Warrington WA4 6AD.

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OXFORD UNIVERSITY

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Applications, including curriculum vitae and the names of two referees, should reach the Administrative Secretary, The Dyson Perrini Laboratory, South Parks Road, Oxford OX1 3QY, as soon as possible, and not later than May 31st, 1974.

THE UNIVERSITY OF ASTON IN BIRMINGHAM

Department of Geological Sciences

TECHNICIAN required for the Department of Geological Sciences, having a special interest in geochemical instrumental techniques (especially Atomic Absorption Spectrophotometry). Qualifications in Chemistry at graduate or HNC level are preferred. Excellent working conditions, 5 day week. Salary within the range £1850 to £1920 p.a. Application forms from the Staff Officer, The University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET, quoting reference L/678/NS.

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TECHNICIAN

required in Medical Physics Department to be involved in a wide range of interesting laboratory work including, for example, Liquid Scintillation Counting, Radioimmunoassay and Data Processing as well as collaborating in clinical research projects. A background including some experience of chemical procedures would be particularly suitable. Experience of data processing not essential since training could be given.

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Application forms obtainable from Chief Education Officer, Summer Road, N.17, returnable by 17 May 1974.

Graduates and Technicians— Anti-Viral Research

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The scientific posts will be filled by graduates holding a Microbiology, Biochemistry, Zoology or Virology degree. Technicians should have at least an HNC in a Biological Science (or equivalent), coupled with laboratory experience in

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Initially please contact Mr H. W. Cooke, Personnel Manager, Research and Development Division, G. D. Searle & Co. Ltd., Lane End Road, High Wycombe or telephone High Wycombe 21124 extension 130 quoting reference ST/129.

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RESEARCH ENGINEERS

For R & D work on Gas Turbines and Jet Propulsion

Research Engineers are needed for experimental and theoretical work at the National Gas Turbine Establishment. Successful applicants will join teams exploiting one of the most comprehensive ranges of propulsion test facilities in the world in the solution of a wide variety of problems in the fields of both civil and military aviation. The disciplines in which initial experience and training are offered include supersonic and subsonic aerodynamics, acoustics, combustion and heat transfer, control systems and the mechanical sciences. However, whilst recognising the importance of specialist knowledge the Establishment also attaches great weight to personal drive, innovative flair, and a readiness to take the broad view.

QUALIFICATIONS:

To join at Higher Scientific Officer level you should preferably be aged under 26. You need to have a good honours degree in an appropriate subject and at least 2 years' post-graduate relevant experience in engineering or physics. Starting salary: £2221-£2854 according to experience.

Joining at Scientific Officer level, you should preferably be under 24 and have a good honours degree in engineering or physics. Starting salary will be at least £1435 on a scale rising to £2329.

For an application form (to be returned by 28 May 1974) write to Mr. I. M. Davidson, the Director, National Gas Turbine Establishment, Pyestock, Farnborough, Hants or telephone Farnborough 44411 ext. 510. Please quote SA/2/FS/4

NATIONAL GAS TURBINE ESTABLISHMENT

WOOL RESEARCH ORGANISATION OF NEW ZEALAND (INC.)

SENIOR SCIENTIST PROJECT

1. to process typical and special New Zealand Wool into finished products and thus provide manufacturers and growers with quantitative information and the performance of various wools in various processing routes and products.
2. In conjunction with other staff, sometimes with other organisations, to assist in the design of modified systems of preparing wool for market to give users greater satisfaction and lower cost of preparation and distribution. Liaison with research workers in the field of wool production and with wool growers throughout New Zealand will be involved.

The organisation is devoted to research on wool utilisation. It has its own Pilot Plant, first class laboratories and a staff of about 90 of whom 30 are graduates mainly with higher degrees in various aspects of Science, Engineering, and Biology.

QUALIFICATIONS

A record of productive research work, leadership, and co-operative ability, preferably in either textiles or agriculture.

SALARY

A starting salary of about 10,000 N.Z. Dollars is envisaged.

Further enquiries or applications with names of two referees should be addressed to:

The Director
WOOL RESEARCH ORGANISATION
Of New Zealand (Inc.)
Private Bag
Christchurch
NEW ZEALAND

MEDICAL RESEARCH COUNCIL

Laboratory Animals Centre TECHNICIAN

required (Junior Technician considered) to assist the Centre's nutritionist who is responsible for investigating the feeding requirements of small laboratory animals. Duties will include analysis of diets and tissues for essential nutrients by a variety of methods. This is an important post in a developing field which offers considerable scope for a person with initiative and experience in analytical procedures, and provides opportunities for further study.

Salary according to age, qualifications and experience, in the range of £1400-£2292, plus London Weighting and superannuation benefits. Social/sports club is also provided at the Centre.

Applicants preferably studying or with a suitable HNC or equivalent should write to the Chief Technician, Medical Research Council, Laboratory Animals Centre, Woodmansterne Road, Carshalton, Surrey, SM5 4EP (Tel: 01-643 8009).

BRISTOL POLYTECHNIC

Department of Science

Applications are invited for the following post, duties to commence as soon as possible.

TECHNICIAN (GRADE T2) IN BIOCHEMISTRY

The successful applicant will assist a Senior Technician with the running of the Biochemistry and Clinical Chemistry Laboratories. Previous laboratory experience is essential.

Applicants should possess as a minimum, an Ordinary National Certificate or City and Guilds Intermediate Certificate or equivalent qualifications.

Day release for further study is encouraged.

Salary Scale: T2 £1242-£1416. Additions of £42 or £72 for appropriate qualifications.

Further details and application form (to be returned by 14 May 1974) from Personnel Office, Bristol Polytechnic, Ashley Down, Bristol BS15 9BU.

Please quote Post Reference Number T2/15/3 in all communications.

ASTRONOMY RESEARCHER

Part-time Astronomy researcher required with good knowledge of Astronomy, to plan and research high quality colour illustrations. Ring Eric Abranson on 039-3711 ext. 34.

Opportunities for Graduates in Research ...

... In the Special Technical Services Section of the General Chemicals Division's Research Department. The Section deals with a wide variety of problems associated with the introduction and development of new products, the design and operation of pilot and large-scale plants, and customer service both in the U.K. and overseas. Candidates, with a good Honours Degree, should be able to demonstrate a direct practical approach to problems. The appointments are:

Physical Chemist

with an interest in corrosion and materials work. Experience or training in Materials Science or Materials Engineering would be an advantage but is not essential. Location: Widnes, after a short initial period in Luton. Ref: AQ.225/1

Corrosion Scientist

with a Metallurgical background, interested in the fabrication of Chemical plant, and failure investigation. Location: Widnes, after a short initial period in Luton. Ref: AQ.225/2

Physical Chemist

interested in hazard investigation including applied studies on fast reactions, fires and explosions. Location: Widnes. Ref: AQ.225/3

Attractive salaries and prospects for future promotion are excellent. The generous Company Pension Scheme is non-contributory and there are good social and sports facilities. Assistance may be given with removal expenses in appropriate cases.

Please write, in the first instance quoting the appropriate reference to:

The Divisional Personnel Manager,



**LAPORTE
INDUSTRIES
LIMITED**

General Chemicals Division,

Moorfield Road, Widnes, Halton, Cheshire.



**TRUMAN
BREWERY**

We have a vacancy for a Laboratory Technician in our Quality Control Laboratory.

Applicants should have 4 G.C.E. 'O' levels including Maths, English and Chemistry. Preferred age 18 to 22. Salary according to age and experience.

5 day week, 9-5. Subsidised canteen. Close to Liverpool Street or Aldgate East Stations.

Applications to:

The Employment Officer,
Truman Limited,
91, Brick Lane, London, E1 6QN.

INSTITUTE OF PSYCHIATRY TECHNICIAN

The Department of Psychology require a Technician for the Departmental Workshop.

Duties will include construction and Maintenance of Electronic apparatus for use in the research carried out in the department. Applicants should possess ONC or C&G Final Certificate or equivalent.

Salary—Technician on a scale £1400-£2292 plus London Weighting (£126).

Starting point dependent on Age, Qualification and experience.

Application forms and details can be obtained from the: The Secretary, Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AF, quoting ref: IM/NS.

RESEARCH TECHNICIAN

Required for English speaking molecular biology department in modern research institute involved in study of viral transformation of animal cell cultures. Experience with general biochemical techniques in enzymology and subcellular fractionation and with general sterile techniques associated with tissue culture useful.

Salary on R.A.T. scale from DM14 600 to DM17 880 p.a., according to experience, plus family allowances.

Applications with the names of two professional referees should be sent to Dr Dennis Jovin, ABT, Molekulare Biologie, Max Planck-Institut für Biophysikalische Chemie, 34-Göttingen-Nikolausberg, POB 958, W. Germany.

ROYAL POSTGRADUATE MEDICAL SCHOOL

BIOCHEMIST

required to take technical charge of a biochemical laboratory in the Urological Unit which has a special interest in the study of kidney and kidney transplantation. The laboratory is well equipped, automated, and there will be ample opportunities for original research. Salary according to qualifications and experience.

Applications to the Secretary, R.P.M.S., Hammersmith Hospital, Du Cane Road, London W12 0HS, quoting ref. no. 3/107/NS.

MRC CLINICAL RESEARCH CENTRE

(Northwick Park Hospital), Watford Road, Harrow, Middlesex, HA1 3UJ

TECHNICIAN

with ADMIT or HNC required for research in the area of immune response to infections; the isolation, characterization and immunology of carbohydrate antigens from biological sources. Experience in microbiology, immunology and/or biochemistry would be useful.

Salary within the range £1400 to £2292 plus £126 London Weighting. Please apply quoting ref. 108A/2 to Mrs. J. Tucker-Bull.

HARROW COLLEGE OF TECHNOLOGY AND ART

Northwick Park, Harrow HA1 3TP

Required for September 1974

LECTURER 1 in CHEMISTRY & PHYSICS for GCE 'A' Level and ONC Science Courses. Applicants should have a degree in Chemistry or Physics. Teaching and/or industrial experience would be an advantage.

Salary (under review) within the range £1175-£2965 according to qualifications and experience.

Further details and application forms, returnable within 14 days, from the Principal.

Laboratory Technician

We have a vacancy for a Laboratory Technician in our Quality Control Laboratory.

Applicants should have 4 G.C.E. 'O' levels including Maths, English and Chemistry. Preferred age 18 to 22. Salary according to age and experience.

5 day week, 9-5. Subsidised canteen. Close to Liverpool Street or Aldgate East Stations.

Applications to:

The Employment Officer,
Truman Limited,
91, Brick Lane, London, E1 6QN.

SCIENTIFIC SERVICES STAFF

RE-ADVERTISEMENT

S2 and S8

Co-ordinator and Principal, Environmental aspects of Water Quality Monitoring and Effluent Regulations (S1) £5300—£6800 pa (S8) £4750—£5250 pa.

S3 and S10

Co-ordinator and Principal, Analytical Techniques and Data Handling (S3) £5300—£6400 pa (S10) £4750—£5250 pa.

S4 and S11

Co-ordinator and Principal, Specialist Laboratory Facilities and Instrument Monitoring (S4) £5300—£6400 pa (S11) £4750—£5250 pa.

S7

Co-ordinator or Principal, Water-based Recreation £4750—£5360 pa. A somewhat higher salary may be paid for exceptional relevant experience.

S9

Principal, Scientific advice on water treatment £4750—£5250 pa.

The Water Services Staff Commission has agreed that these posts may be advertised without restriction. Previous applicants need not re-apply. Application forms may be obtained from the Director of Administration, Severn-Trent Water Authority, Abolton House, 2297 Coventry Road, Sheldon, Birmingham B26 3PR and should be returned not later than 14th May 1974.


**Severn-Trent
Water Authority**

ASLIB: THE RESEARCH ASSOCIATION FOR INFORMATION MANAGEMENT

The demand for contract research and consultancy facilities in the information field has grown steadily in recent years, and is likely to increase, especially in Europe. We therefore wish to appoint a new project leader to join our Consultancy Service, which is responsible for carrying out contract work for member organizations in the UK and abroad. Our clients have included industrial firms, professional institutions, government bodies, academic and public libraries, and international organizations, or the work is varied, and involves:

- designing and setting up new information systems or libraries of various kinds;
- reviewing and evaluating existing services and advising on their future development;
- advising on the use of specific techniques (including computer techniques) for information handling or library processing.

Much of the technical expertise required for this work can be supplied from within the Research and Development Department, to which the Consultancy Section is attached, so applicants will be expected to have a general, rather than an encyclopaedic, knowledge of information science. The problems we are called upon to solve do, however, involve human, managerial and sometimes political factors; and essential requirements for the post we are trying to fill are:

- a keen interest in the solution of complex, and often novel, problems in the information field;
- objectivity in gathering and analysing the data on which decisions can be based;
- ability to communicate the results and conclusions of an investigation to the client organization.

The person appointed will also have to exercise initiative in seeking out new opportunities for contract work and in negotiating with potential clients.

The kind of person we are hoping to recruit could be a practising information scientist with a flair for systems design, or a specialist from a field such as operations research or computer science with an interest in information problems. Our office is in London, and the work entails a certain amount of travelling. The preferred age group would be 28-40, and a degree and/or professional qualification would be required. Starting salary will be in the range £1000-£1500, depending on age, experience and qualifications.

Applications should be addressed to The Director, Aslib, 3 Belgrave Square, London SW1X 8PL.

ANIMAL PHYSIOLOGY/ PHARMACOLOGY

Radioactive pharmaceuticals occupy an important and growing place in diagnostic medicine.

The Radiochemical Centre is expanding its team studying the physiological aspects of new products. We are looking for a graduate with research experience in animal physiology and pharmacology to take responsibility for developing "in vivo" techniques and analytical methods as well as to supervise the day-to-day work of a small team.

We are located in an attractive rural area of Buckinghamshire yet have easy access to London by Underground.

The salary will be on a scale with a maximum of £3,055 per annum. Conditions include 4 weeks' annual holiday, a contributory superannuation scheme, staff canteen and a sports and social club.

Assistance with house purchase may also be available.

Telephone Little Chalfont 4444 for an application form or send a curriculum vitae including relevant career history to The Personnel Officer



The Radiochemical Centre

Amersham

Bucks

NATIONAL INSTITUTE FOR MEDICAL RESEARCH

JUNIOR TECHNICIAN/TECHNICIAN

required to assist in research on the metabolism of plasma proteins in the Division of Biophysics. Candidates should have a minimum of 4 GCE 'O' levels including biology and chemistry and preference will be given to those with GCE 'A' levels which should include chemistry. Experience of immunological methods would be an advantage. Those with GCE qualifications will be appointed as Junior Technicians on scale £834 p.a. (at 16) - £1521 p.a. while HNC holders will be considered for appointment as Technicians £1566 p.a. - £2418 p.a. Please apply to P. A. Collingridge, N.I.M.R. The Ridgeway, Mill Hill NW7 1AA. Tel: 959-3666.

UNIVERSITY OF MANCHESTER

Department of Physics POSTDOCTORAL RESEARCH

Applications invited for a two-year postdoctoral appointment (from October 1st) to study molecular dynamics of condensed matter by laser light scattering. The group is currently studying molecular motion and properties of synthetic and biological macromolecules by techniques which include photon correlation spectroscopy. The post is suitable for candidates who have a background in Physics or Chemistry; previous experience in light scattering or macromolecular research an advantage but not necessary. Salary range £1925-£2555 p.a. Further information may be obtained from Dr V. A. King, Physics Department, The University, Manchester, M13 9PL, to whom applications should be sent together with the names of two referees as soon as possible.

NATURAL ENVIRONMENT RESEARCH COUNCIL

Unit of Invertebrate Virology

A vacancy exists in the UV Oxford for an assistant scientific officer/scientific officer to join a team concerned with the isolation, purification and characterisation of insect viruses.

Qualifications: ASO—minimum of GCE 'O' level or equivalent in four subjects, including English language, and a science or mathematics subject. SO—normally under 27. A degree in an appropriate subject or IMET, HNC, HND or equivalent.

Salary: ASO—£729 (age 16) rising by annual increments to £1514 p.a. (age 30). SO—£1435 to £2229 p.a. (starting salary dependent on age and experience).

Further details and application forms may be obtained from the Laboratory Superintendent, UV, Commonwealth Forestry Institute, South Parks Road, Oxford.

ST THOMAS' HOSPITAL

London, SE1 7EH

SENIOR TECHNICIAN/ TECHNICIAN

required for Department of Surgical Pathology. This department provides a comprehensive histological service to the St. Thomas' group of hospitals having a workload of approximately 12,000 surgical specimens and 6,000 cytological specimens per annum. There is a technical staff of 11. The laboratory is scheduled to move into the new hospital in 18 months. Applicants should have a wide range of histopathology and will be expected to take an interest in the training of junior technical staff. Some research interest will be an advantage. Enquiries to: Dr. Turvey, Chief Technician 928 9292. Ext. 2549 and application forms and job descriptions from the Personnel Officer, 79 York Road, London, SE1 7NY.

Council for Scientific and Industrial Research South Africa

The Council for Scientific and Industrial Research consists of 15 national research laboratories and institutes. The CSIR undertakes and promotes scientific and industrial research into matters affecting the utilisation of the natural resources of the Republic; on the development of its industries and on the proper co-ordination and employment of scientific research to these ends.

The following vacancies are available in its NATIONAL CHEMICAL RESEARCH LABORATORY, PRETORIA.

BIOCHEMISTS

(ref 73/60/289) required for research on structure-function relationships of biologically active macromolecules. The programme envisaged includes the interaction of phospholipase A, cytochromes, toxalbumins and other lectins with biological membranes. Excellent facilities and expertise in protein isolation, structure determination and physico-chemical characterisation are already available.

Posts are available on two levels, according to qualifications and experience:

Salary A: Between R8 300 and R10 700 (£5500 and £7150 approx) p.a.

Salary B: Between R5 000 and R7 950 (£3300 and £5300 approx) p.a.

Applicants with extensive experience in leading a research team will be considered for a position on the level of salary scale A.

CONDITIONS OF EMPLOYMENT: The many benefits include medical benefit scheme, assisted housing loan scheme, housing subsidy scheme, annual leave bonus, pension and group insurance scheme and annual leave up to 35 days. Successful candidates will receive assistance with travelling expenses and a contribution towards transportation of household effects. They will be required to make use of the Government immigration scheme and to serve the Council for two years in return for financial assistance.

Please apply to the following address:

The Office of the Scientific Counsellor,
Chichester House, 278 High Holborn,
London WC1V 7HE.
Telephone: 01-242 9641

Further details and application forms may also be obtained from this address.

QUEEN MARY COLLEGE

(University of London)
Mile End Road, E1 4NS
PLANT ECOLOGY
TECHNICIAN
(Grade 3)

Required to assist with teaching in physiological ecology in the Department of Plant Biology and Microbiology. Present research is concerned with climatic effects on native British plants, and the post will include the maintenance of four controlled environment cabinets and experimental glasshouses.

Applicants should have at least two 'A' levels and similar qualifications with experience in Biological Science, Agriculture or related subject. Five weeks (ten total) annual leave. Five day week plus occasional weekend watering. Salary £1650 x £54-1650 per annum plus £175 p.a. London Weighting. Letters to Assistant Secretary (Establishment) for details of qualifications, experience and present employment.

UNIVERSITY OF SYDNEY

ELECTRON MICROSCOPIST

Applications are invited for the position of Electron Microscopist in the Electron Microscope Unit. The Unit provides a central Electron Microscopy both by way of research facilities and training courses to the various Departments. In addition to the advertised position, the Unit's staff includes a Director and two Assistant Electron Microscopists. Applicants for this vacancy should be experienced in the biological aspects of electron microscopy.

Salary within range: £A855-£A1100 p.a. or £A925-£A1150 p.a. according to qualifications and experience.

Applications including curriculum vitae, list of publications and names of referees by 15 May 1974 to the Registrar, University of Sydney, NSW 2006, Australia, from whom further information available.

OXFORD UNIVERSITY Nuclear

Physics Laboratory. Electronic Technician. A technician exists for a Technician in the Electronics Workshop. Duties include servicing and maintaining wide range of digital and analogue electronic equipment used in nuclear structure research, and the development and construction of new equipment. Applicants must possess a theoretical knowledge of about HNC standard and a formal qualification would be an advantage. Proven practical ability in the field is considered essential. Salary will be within a range rising to £2352, with eight weeks paid annual leave. Day release for relevant studies may be granted if appropriate. Applications giving full names, age, age, experience and qualifications should be sent to: T. L. Green, Nuclear Physics Laboratory, Keeble Road, Oxford. (Mention reference A.15).

SENIOR TECHNICIAN

Department of Human Metabolism,
St. Mary's Hospital Medical School, W.2

Senior Technician required as soon as possible to carry out technical administration of the Department and to take part in interesting research projects including carbohydrate and lipid metabolism, and endocrinology.

Informal visits may be arranged with Mr. R. Newall.

Applications, with curriculum vitae to:

Professor V. Wynn

The Alexander Simpson Laboratory

For Metabolic Research

St. Mary's Hospital Medical School

London, W.2.

Tel: 01-723 1252, Ext. 126

STATISTICIAN FOR A MEDICAL RESEARCH COUNCIL UNIT IN EDINBURGH

A statistician, who will be senior amongst several on the scientific staff of the Unit, is required to work on the design and analysis of experiments in cell biology and genetic linkage, to advise on the biometrical aspects of cell behaviour and to assist in studies on the epidemiology of human chromosome abnormalities.

Substantial in-house computing facilities, a high speed link to the Edinburgh Regional Computer Centre and programming support are available.

Applicants should have suitable academic qualifications and considerable experience in applied statistics, preferably in the biological sciences. The position offers excellent opportunities for collaborative work in a wide range of biological and medical projects, especially for someone who interests include the biomedical field as well as statistical theory and technique. Commencing salary in the range £1830-£4546 with possible promotion to Senior Grade.

To apply, or for further information, please contact the Director, MRC Council and Population Cytogenetics Unit, Western General Hospital, Crewe Road, Edinburgh EH4 2XU.

UNIVERSITY OF THE WITWATERSRAND

Johannesburg, South Africa
Department of Chemical
Engineering—
LECTURERS

Two lecturers are required to assume duty as soon as possible or at a date to be negotiated. For one post an interest in chemical engineering design or electrical engineering applied to mineral processing would be an advantage. Good opportunities for research and contacts with industry exist.

Initial salary depending on qualifications and experience will be in the range R550-R755 (R1 approximately £0-65 and US\$1-50). Benefits include pension and medical aid facilities, an annual bonus and, if eligible a housing subsidy.

Intending applicants should obtain the information sheet relating to this post from the Registrar, University of the Witwatersrand, Jan Smuts Avenue, Johannesburg, South Africa, with whom applications should be lodged not later than 30th June 1974. Applicants in the UK and USA may obtain the information sheet from the London Representative, University of the Witwatersrand, 278 High Holborn, London WC1 to whom a copy of the application should be sent. Interviews in London and Washington can be arranged.

SCIENTIFIC SECRETARY

A part-time position of Scientific Secretary to the Eugenics Society will become available in August. The Society is concerned broadly with the biological aspects of human populations and the post would be suitable for a social scientist with an awareness of biological problems or a natural scientist with inter-disciplinary interests.

This new position will give the individual time for developing his research interests, as well as being involved in the organisation of annual symposia and the Society's quarterly publication. Encouragement will be given to the person appointed to extend the scientific work of the Society. Support would also be given in any application for funds to transform the position into a full-time appointment at the Society's premises. Previous administrative experience would be an advantage.

Salary according to age and qualifications within the range £150-£250 for 3 days per week or the equivalent and superannuation cover will be arranged.

Further details may be obtained from the General Secretary, the Eugenics Society, 68 Eccleston Square, London SW1V 1PJ, to whom applications should be submitted not later than 31st May.

MEDICAL RESEARCH COUNCIL

An adequately qualified technician required to work in the Veterinary Laboratory of the Laboratory Animals Centre, Woodmansterne Road, Carshalton, Surrey.

The position calls for an experienced person with the ability to adapt and/or devise techniques for incorporation into a comprehensive routine for the diagnosis of disease in a wide range of laboratory animals, mainly using serological procedures.

The ability to work on his own initiative and with a minimum of supervision, calls for a high level of self-starting and self-maintaining potential.

For the right person, this could be a most rewarding position in a little known but expanding field.

Salary scale ranging from £1440-£2282 plus London Weighting.

Application forms available from the Chief Technician's Office or telephone 01-643 8000.



Science Research Council Appleton Laboratory Sounding Rockets Division Vacancies for Engineers

There are three vacancies as detailed below in the Procurement Group of the Sounding Rockets Division. The Group's primary task is to provide the rocket vehicles and supporting services for the Science Research Council's sounding rocket programme. The rockets carry experiments provided by Universities and Government Departments for research in astrophysics and geophysics.

1. Professional and Technology Officer Grade I

DUTIES

To specify in collaboration with contractors and to keep under review such areas as aerodynamic design, flight characteristics, structural integrity, motor performance, rocket motor ignition switching, pyrotechnic devices and the design of parachute systems. He will be required to supervise R & D in some of the above areas and advise on the design of balloon payload structures.

QUALIFICATIONS AND EXPERIENCE

Applicants should be research orientated, have corporate membership of a professional institution and have had experience in related areas to the duties described above.

Experience in some of the following areas of work is desirable: Rocket electrical, mechanical and pneumatic subsystems, payloads, data transmission and reduction, flight instrumentation such as rate gyros, accelerometers, attitude sensors, magnetometers, tracking beacons and telemetry systems.

Salary, according to experience, on the scale £3062-£3923 (currently under review).

2. Professional and Technology Officers Grade II and III

Both officers to work in a team engaged on the specification and technical management of rocket procurement.

DUTIES FOR PTO II

Write specifications for the supply of goods and services, by Contractors and Government Departments, covering flight hardware, ground equipment and supporting facilities.

Check and control procurement schedules and monitor the supply of parts, process additions to schedules, forecast future component requirements for extended programmes, control holdings of test and other equipment held by contractors at their premises and at launch sites.

DUTIES FOR PTO III

Establish and maintain a comprehensive records system to cover new components, modifications and defects reports. This will include test equipment and ground facilities.

Review the technical costs on contracts, draw up detailed cost lists for future programmes, co-ordinate the refurbishing of recovered parts including monitoring of costs.

QUALIFICATIONS AND EXPERIENCE

Applicants for these posts should normally possess an Ordinary National Certificate but possession of an HNC would be an advantage, as would experience in working on the supply of items required for space, missile or aircraft programmes.

Salary, according to experience, on one of the following scales:—

PTO II £2536-£3062 (currently under review)

PTO III £2226-£2536 (currently under review)

The Council has a non-contributory superannuation scheme.

Application forms, to be returned by the 16th May, are obtainable from the Secretary, Appleton Laboratory, Ditton Park, Slough, Bucks. Tel: Slough 44234.

Department of the Environment

OR Project Team Leaders

£3890-£5070
London

... to identify and manage OR studies, liaise with consultants engaged for specific projects, and guide and develop junior members of a multi-disciplinary team.

Projects which are of current importance are in the fields of financial and staff planning, building maintenance, purchasing, and management information and accounting systems. The work involves the use of mathematical models, and a key requirement is often to provide a professional contribution to decision making processes within a limited time-scale.

Candidates should normally have a relevant 1st or 2nd Class honours degree. They must be able to demonstrate considerable success at a responsible level in the application of operational research.

Starting salary will be within the quoted scale, and there are good prospects of promotion. Non-contributory pension scheme.

For full details and an application form (to be returned by 28 May, 1974) write to Civil Service Commission, Alencon Link, Basingstoke, Hants., RG21 1JB, or telephone BASINGSTOKE 29222 ext. 500, or LONDON 01-839 1992 (24 hour answering service). Please quote S/8556/4

yardley

Manufacturers of Perfume, Cosmetics and Fine Soaps

Have a vacancy for an

ASSISTANT

in the Research and Development Laboratory

An Assistant is required for the R & D section of our laboratory to carry out interesting work connected with Component/Product Compatibility and Packaging technology, under the supervision of a senior chemist.

As a basic qualification, applicants must possess either O.N.C. (Chemistry) or A levels in Chemistry and Physics. Some industrial experience in the above or related fields would be advantageous, and the successful applicant will be encouraged to continue his studies.

Please write or telephone Mrs. S. F. Blake Personnel Officer

YARDLEY OF LONDON LIMITED
4 Miles Gray Road, Basildon, Essex.
Telephone: Basildon 22711 extension 18

ST. THOMAS' HOSPITAL

London, S.E.1

TECHNICIAN

required for Quality Control Laboratory in the Pharmacy Department. Salary scale £1440 - £2292 plus £126 London Weighting. Chemical and physical analyses using Pharmaceutical methods. HNC or HND qualifications.

Applications to Personnel Officer, 79 York Rd., London SE1 7NY

CRANFIELD

Acoustics Research

A vacancy for a Research Officer exists within the Environmental Sciences Research Unit in contract research directed toward the theoretical and experimental treatment of environmental noise problems. We require a good honours graduate who will be involved with the detailed specification and overall control of a diverse range of acoustic projects and environmental surveys. Candidates should be capable of applying fundamental principles of acoustics to the solution of practical problems, and will have a good working knowledge of experimental techniques of acoustic measurement. Practical experience of site acoustic and vibration measurement would be a definite advantage, but new graduates or MSc students demonstrating the right qualities would certainly be considered.

Present salary scale for Research Officers is £1929-£2883 p.a., but is under review. For application form and further details apply to: The Secretary (Appointments), Cranfield Institute of Technology, Cranfield, Bedford, MK43 0AL, quoting reference 555.

ROYAL COLLEGE OF ART

Department of
Design Research

RESEARCH ASSOCIATE

A Research Associate is required to join a multidisciplinary team studying and creating models and modelling techniques as aids to designers. Study involves working closely with teams of designers and architects dealing with the problem of hospitals and hospital equipment.

Applicants should have an honours degree or equivalent background in one or more of the following disciplines: Operational Research, Applied Mathematics/Statistics, Computer Science, Psychology.

Design or architectural experience would be an advantage in addition to an interest in the development of inter-active or graphical techniques.

Salary according to qualifications and experience. Apply for further details and application form to: The Research Tutor, Department of Design Research, Royal College of Art, Kensington Gore, SW7 2EU.

SCIENTIFIC SECRETARY

A part-time position of Scientific Secretary to the Eugenics Society will become available in August. The Society is concerned broadly with the biosocial aspects of human populations and the post would be suitable for a social scientist with an awareness of biological problems or a natural scientist with inter-disciplinary interests.

This new position will give the individual time for developing his own research interests, as well as being involved in the organisation of annual symposia and the Society's quarterly publication. Encouragement will be given to the person appointed to extend the scientific work of the Society. Support would also be given in any application for funds to transform the position into a full-time appointment at the Society's premises. Previous administrative experience would be an advantage. Salary according to age and qualifications within the range £1500-£2500 for 3 days per week or the equivalent and superannuation cover will be arranged.

Further details may be obtained from the General Secretary, The Eugenics Society, 69 Eccleston Square, London SW1V 1PJ, to whom applications should be submitted not later than 31st May.

UNIVERSITY OF TASMANIA

LECTURER IN
AGRICULTURAL
MICROBIOLOGY

Applications are invited for the above mentioned appointment within the Faculty of Agricultural Science. The University would particularly welcome applications from people with training and experience in soil microbiology but the applicant will be expected to participate in teaching of general microbiology. He will be required to participate in supervision of honours and postgraduate students, and to undertake a personal research programme.

The salary scales are:— Gr. 1 \$A10 575-681 x 3-511 962; Gr. 11 \$A10 681-70 x 3-460 x 2-510 106. Appointment will be offered within these grades according to qualifications and experience.

Further particulars and application forms from the Association of Commonwealth Universities (Assoc.), 36 Gordon Square, London WC1N 0PF.

Applications close on 24 May 1974.

UNIVERSITY OF SOUTHAMPTON

Faculty of Medicine LECTURESHIP IN HUMAN MORPHOLOGY

Applications are invited from biological graduates, preferably with a PhD, or from medical graduates for a teaching and research appointment in Human Morphology. Previous teaching experience is not essential; good research facilities are available in a variety of fields and experience in electron microscopy would be an advantage. Salary scale £1,929-£4,548 per annum (by 16 increments) subject to review. Initial salary will depend on qualifications and experience. Enquiries should be directed to Professor D. Bulmer or Professor D. Meyer, Medical and Biological Sciences Building, Bassett Crescent East, Southampton from whom further particulars may also be obtained. Applications should be addressed to the Deputy Secretary (Ext. 2804), The University, Southampton, SO9 4NH (7 copies from applicants resident in UK and one from others) not later than 31 May, 1974. Ref NSC.

AGRICULTURAL RESEARCH COUNCIL UNIT OF NITROGEN FIXATION

Research Assistantship for Chemist

There will be a research post available in the Unit of Nitrogen Fixation, whose Director is Professor I. Chitt, FRS, from October 1974 for a period of 3 years, for a graduate with a 2:1 degree or better, wishing to take a DPhil degree in the University of Sussex.

The work will lie in the field of organo-transition metal and coordination chemistry. Financial arrangements parallel those of an SRC Studentship. Research facilities are good. Apply to The Administrator, Unit of Nitrogen Fixation, University of Sussex, Brighton, Sussex BN1 9QJ.

UNIVERSITY OF ABERDEEN RESEARCH ASSISTANT IN CHEMICAL PATHOLOGY

Applications are invited from graduates for above post in biochemical and immunological studies on lipoproteins in artery walls; interest in histochemistry an advantage but not essential. The research project is supported by an MRC grant. Salary on scale: £1386-£1659 (meantime under review).

Further particulars from The Secretary, The University, Aberdeen, with whom applications (2 copies) should be lodged by 11 May, 1974.

SOCIETY FOR ANALYTICAL CHEMISTRY EDITORIAL STAFF

An opportunity exists for an editorial assistant to work on the publications of the Society in central London. A good knowledge of chemistry is required and a degree or equivalent qualification is desirable. Previous editorial experience is not essential but would be an advantage. Apply with full details to the Managing Editor, Society for Analytical Chemistry, 9-10 Seville Row, London W1X 1AF.

Look into the future of optics with Rank Xerox

The contribution Rank Xerox has made to new developments in the field of xerographic end office communication products cannot be overestimated.

High precision optical systems feature strongly in all these products, and in the new products under development in our laboratories at Welwyn Garden City. Our Optics Department is concerned with such areas as optical systems design, image evaluation, image processing, displays and information transmission. The atmosphere is professional and stimulating. The work is complex and demanding. And the future, for the people we're looking for, is as unlimited as it is for our products themselves.

Optical Engineer/ Radiometry

Our Optics Department has recently invented a novel type of illuminator. A Physics Graduate is required to further develop the basic invention into a family of product oriented devices. The Radiometry Laboratory is well equipped with modern photometric apparatus and a computer is available for design studies. Ideally, applicants for this post should have some experience in optics, but serious consideration will be given to new graduates with an interest in the subject.

Scientist for Visual Optics/ Image Evaluation

Measurements made of characteristics of copies, photographs, colour xerographic images, microfilm images etc., reveal some physical parameters, but these parameters have to be related to how an observer evaluates the images. We seek a graduate scientist to help us in this work. The position calls for a person with probably a minimum of two years' experience in one or more of the following areas, image evaluation, visual sciences or photographic research.

Newly-qualifying Graduates

We will be continuing to expend the Department during the course of the year, and will be interested to hear from newly qualifying graduates in Physics or Optics, keen on an exciting career with a company which is constantly pushing the frontiers of technology.

The Company offers above average fringe benefits including generous assistance with relocation expenses where appropriate.

Please write or telephone for an application form to Mr. A. Preston, Rank Xerox Ltd., Bessemer Road, Welwyn Garden City, Herts. Telephone No. Welwyn Garden 28177, Extension 19.

RANK XEROX

ENGINEERING GROUP

PHYSICISTS, ENGINEERS and CHEMISTS

British Nuclear Fuels is currently engaged upon a large scale programme of development work to support the commercial introduction of the gas centrifuge for enrichment of uranium.

Qualified physicists, engineers (mechanical and electrical) and chemists are now needed to expand the Company's development activities at Capenhurst, Nr. Chester. Posts are available for candidates with a good honours degree and, in addition, for those at pass degree/HND/HNC level. Previous laboratory experience would be an advantage but is not essential.

Depending on qualifications and experience, appointments would be either on the salary range £2,550 to £3,510 p.a. or on £1,540 to £2,485 p.a. Both scales are currently under review. There is scope for advancement for those who show proof of their ability to take wider responsibility.

Conditions of service are good and there is a contributory pension scheme.

For application forms please send a postcard to the Personnel Manager, British Nuclear Fuels Limited, Capenhurst Works, Nr. Chester, Cheshire, CH1 6ER quoting Ref. CAP/529/J17



BRITISH NUCLEAR FUELS LIMITED

Research Officers Biological Sciences

Huntingdon Research Centre is the largest contract research organisation in Europe operating in the biological sciences area. Due to promotion and expansion of our activities we now need to recruit further Research Officers with degrees or HNC qualifications in related subjects.

Irritant Toxicology

Work undertaken will be within a team assessing the effects of compounds when applied to the skin including irritation, sensitization and systemic toxicity.

A competitive salary will be offered depending upon age and particular experience, relocation expenses will be paid, and working conditions are excellent including a particularly active sports and social club.

Further details on these positions may be obtained from Mrs. N. McCree, Recruitment Officer, Huntingdon Research Centre, Woolley, Huntingdon PE18 6ES, telephone Woolley 431 ext. 251. Closing date for applications 31st May 1974.

H.R.C.

Huntingdon Research Centre

Pharmacology

Broad experience is required, gained within an industrial, hospital or academic environment. Mathematical knowledge and experience of the use of computers would be an advantage.

UNIVERSITY OF TASMANIA LECTURER IN AGRONOMY

Applications are invited for the above-mentioned appointment within the Faculty of Agricultural Sciences.

The salary scales are:—Gr. 1 \$A10 575-\$A468 x 3-\$A11 982; Gr. II \$A880-\$A470 x 1-\$A469 x 2-\$A10 106. Appointment will be offered within these grades according to qualifications and experience.

The particular field of interest of the Senior Lecturer in Agronomy (Dr. J. J. Yates) is the ecology of pastures. The faculty is particularly interested in applications from people with training and research experience in applied Genetics, including both plant and animal breeding. The appointee would also be required to lecture in some aspects of general Agronomy and it would be of great assistance if he could also assist in lectures on biometry in the fourth year compulsory unit, Agricultural Research and Extension Methods. The appointee would be expected to participate in the supervision of honours and postgraduate students and to undertake a personal research programme.

Further particulars and application forms obtainable from Association of Commonwealth Universities (AppUs), 36 Gordon Square, London WC1H 0PF.

Applications close on 24 May 1974.

WELSH NATIONAL SCHOOL OF MEDICINE

(University of Wales)

Department of
Medical Microbiology

Applications are invited for a Research Assistant for Professor J. F. Watkins (who will be taking up his appointment on the 1st October, 1974). The appointee will work on the Cell Biology of Tumours and Tumour Viruses.

Previous experience not essential. Post suitable for a new graduate in biological sciences who would not wish to work for a higher degree.

Salary either on the scale £1380-£212 or on the technical scales depending on qualifications and experience.

Applications, with the names of two referees, to the Registrar, The Welsh National School of Medicine, Heath Park, Cardiff, CF4 4XN, within three weeks of the appearance of this advertisement.

LIVERPOOL POLYTECHNIC Department of Biology

Applications are invited for the post of NERC Research Assistant to work under the direction of Dr M. K. Hughes on the development of X-ray densitometry and tree-rings as an ecological tool.

Appointment is for 3 years from 1st July, 1974.

Salary—£1251, £1311, £1357 per annum.

Details available from Staff Office, Dept. NS, Liverpool Polytechnic, Richmond House, 1 Rumford Place, Liverpool, L3 9RH.

ST BARTHOLOMEW'S HOSPITAL

London EC1

TECHNICIAN III

required to work in large Bio-Mechanical Engineering department. This is a completely equipped workshop dealing with mechanical and electrical problems. Salary will be on the scale £1719 to £2211 per annum plus £126 London Weighting. Applications to Personnel Department giving full particulars and quoting FT/4424/NS.

**NORTH EAST LONDON
POLYTECHNIC**

Applications are invited for the post of:

**SENIOR TECHNICIAN T4
(3 posts)**

based at our West Ham Precinct.

PSYCHOLOGY This post in the Department of Psychology involves working with children and parents at the Department's Child Study Centre and responsibilities include security and maintenance of equipment in the Centre and care of a small animal house.

Candidates should have some relevant experience and preferably a knowledge of recording equipment.

BIOCHEMISTRY This position in the Department of Applied Biology involves responsibility for the satisfactory servicing of degree level practical classes in biochemistry including supervision and training of Junior staff. Candidates should possess Final City and Guilds, HNC or equivalent. Experience of the use of advanced biochemical instrumentation will be considered an advantage.

PHYSIOLOGY The physiology section of the Department of Biological Science comprises a wide range of laboratories and specialist rooms dealing with teaching to honours degree level and research in Physiology.

The successful candidate will be second in charge of the section and applicants must have appropriate qualifications to HNC or equivalent level and experience at a responsible level in one or more areas of Physiology.

Salary on a scale ranging from £1749 to £2031 per annum inclusive.

The West Ham Precinct houses the Faculties of Science and Human Sciences and provides an extensive range of advanced facilities for teaching and research. Sports, canteen, library and other facilities are also available.

Further details and application forms from: The Staffing Officer, Ref: 5/BJ 143, North East London Polytechnic, West Ham Precinct, Romford Road, Stratford, E15 4LZ. Telephone: 01-555 0811. Please contact: Technicians Unit, Ext 33. Closing date: 10 May 1974.

**MARKETING OPPORTUNITY WITH
CORNING-EEL**

We are market leaders in scientific and bio-medical instrumentation and are presently undergoing a strengthening of our marketing team to accommodate our exciting growth rate for the future.

We have a position as Product Manager in our marketing department for an enthusiastic and capable graduate with experience in the marketing of bio-medical and medical instruments.

The position is a demanding and rewarding one carrying authority and responsibility and can lead to meaningful advancement both within the company and the world-wide Corning organisation.

The Product Manager will report to the Marketing Development Manager and be engaged in the planning, co-ordination and direction of marketing programmes aimed at increasing turnover by identifying new product opportunities, expanding into new marketing areas and increasing penetration in existing markets.

A knowledge of market research techniques and statistical analysis is desirable as is the working knowledge of at least one foreign language for as there will be a considerable amount of world-wide travel involved in the job. Age range 25 to 35.

If you are interested in working in a challenging environment where your ability will be recognised and rewarded then contact the Personnel Manager on Helstead 2461 or write to:

Corning-EEL
Eveson Electronics Limited
Colchester Road, Haleshead, Essex
CO9 1DX



in Australia

Research Leader

Animal Health

We are seeking a highly qualified and experienced scientist to head an Animal Health Research Team in our Associate Company in Australia. The laboratory is attractively situated near Melbourne.

ICI Australia has made a number of major contributions to veterinary science and is planning a substantial expansion in its animal health research effort.

The position: The Research Leader will be responsible to the Research Manager of ICI Australia Ltd. for the planning and direction of the Company's research in the area of Animal Health, particularly the development of agents for the control of animal parasites and for the regulation of animal metabolism, on a world-wide basis. The staff include chemists, biologists and biochemists and the final team will number about 40 research workers.

The Research Leader's first duty will be to build up this team with the assistance of colleagues and Personnel Department staff and he should be willing to undertake the difficult task of selecting the right people. Liaison with the parent company's extensive research

organisation in the UK will be an important function and some overseas travel will be required.

Qualifications: The applicant should be a graduate in veterinary or biological science. Extensive research experience is essential and he should have proven ability in research planning and organisation. Industrial research experience would be desirable but not essential.

Age: Age is not critical. Qualifications, experience and suitability for the position are the major criteria.

Salary and Conditions: This is a senior staff position and an attractive salary will be offered. For an outstanding candidate a salary at Reader to Professorial level will be negotiated. Benefits include a contributory Staff Pension Fund, liberal recreational leave and a non-contributory medical benefits scheme. Removal and travel expenses will be met by the Company and housing assistance will be provided.

Applications in writing to: J. Leak, Assistant Personnel Manager, ICI Ltd., Pharmaceuticals Division, Alderley House, Alderley Park, Macclesfield, Cheshire.

Upjohn

medicine . . . designed for health . . . produced with care

analytical chemist

CRAWLEY - SUSSEX

A vacancy has arisen within our International Product Research and Development Division for an Analytical Chemist, reporting to the Senior Analyst.

This important post will be of particular interest to graduates having 3-4 years experience, including analytical development, in the pharmaceutical or allied industry, and who are seeking a position with some administrative responsibility.

The person appointed will have ample opportunity to make significant contributions to the development of analytical methods for new drug molecules, including both bulk and formulated drug. He will have responsibility for analysis of samples in stability programmes, requiring effective communication with people of other disciplines.

To help him carry out these functions, the analyst will have the support of assistants and modern instrumentation.

If this post, offering the opportunity to join a forward looking organisation, is of interest to you, would you write requesting an Application Form to,

The Personnel Manager, Upjohn Limited, Fleming Way, Crawley, Sussex.

U. 193

Department of the Environment
London

Highway Project Analysis

■ To be concerned with highway feasibility studies and their assessment ■ Liaise with other Divisions and consultants ■ Initiate and manage research in this field aimed at improving methods used.

□ 1st/2nd honours degree in Mathematics or a scientific or engineering subject □ 4 years' postgraduate experience □ Experience in using mathematical models and good analytical background desirable □ Interest in planning and some knowledge of economic methods an advantage □ Age under 32 □ Appointment as Senior Scientific Officer (£2973-£4070) □ Ref: SA/H/H.

Application forms (for return by 24 May 1974) from Department of the Environment, Room 446, Lambeth Bridge House, Albert Embankment, London SE1, telephone 01-735 7611 ext. 1469/2094.

British Museum (Natural History)

Serials Librarian

■ To select, acquire and catalogue scientific periodicals in Museum's General Library.

□ Degree/HNC, preferably in biological or earth sciences □ Relevant experience and/or ALA qualification desirable □ Knowledge of one or more foreign languages an advantage

□ Age under 30 □ Appointment as Scientific Officer (£1610-£2504) or, with several years' postgraduate experience as Higher Scientific Officer (£2967-£3029) □ Ref: SB/12/DK.

□ Application forms (for return by 24 May 1974) from Civil Service Commission, Alencon Link, Basingstoke, Hants, RG21 1JB, telephone Basingstoke 29222 ext. 500 or London 01-839 1992 (24-hour answering service).

Department of the Environment
Directorate General Water Engineering, Reading

Computer Scientist

■ In Hydrometric Data Processing Unit ■ Computer processing of river flow data particularly error detection ■ Liaise with river authorities on data collection ■ Supervise setting up the Surface Water Archive.

□ Degree, HNC in appropriate subject □ Age under 27 □ Appointment as Scientific Officer (£1435-£2329) □ Ref: SA/2/HF.

□ Application forms (for return by 28 May 1974) from Department of the Environment, Room 446, Lambeth Bridge House, Albert Embankment, London SE1, telephone 01-735 7611 ext. 1469/2094.

**Science
group**
CIVIL SERVICE

A CHEMIST IS REQUIRED by a Company engaged in the field of research chemical marketing. The function is to assist our purchasing officer. A good knowledge of organic chemistry is needed, together with the desire to emigrate from the bench to the desk, and to learn to work with systems. Apply in writing to: Mr D. A. Allen, Ralph N. Emanuel Ltd, 264 Water Road, Wembley, Middlesex HA0 1PY.

RESEARCH TECHNICIAN required immediately for chemical studies into renal stone formations. Previous research experience not essential. Salary £700-£1400 p.a. depending on age and experience. Apply by letter to Dr. G. A. Rose, (NS) St. Paul's Hospital, Endell Street, London WC2.

RESEARCH AND DEVELOPMENT

New opportunities in Ulster

The R. & D. Division of Gelliaher Limited, based in Belfast, is carrying out vital work in improving the health characteristics of smoking. Increasing the impetus of this work creates a number of new posts for able scientists, who will have excellent facilities for the work and opportunities for rapid personal development. The Laboratories work a 41 day week.

GROUP LEADER - BIOLOGY GROUP

The Group of about fifteen people works broadly in Biochemistry, Toxicology and Cell Biology. It devises and develops biological systems for assessing the properties of new materials that may be smoked and for predicting their long-term effects. The Group Leader reports directly to the Research Manager. He must have a good Honours Degree and relevant biological research experience. He will also be involved in co-ordinating research projects in Europe. Therefore knowledge of French and/or German would be advantageous. We seek an exceptional scientist (age group 30-40) and offer him or her an exceptional opportunity.

BIOLOGICAL SCIENTISTS

Two new posts for graduates in their twenties are available in the above Biology Group, one in biochemistry, the other in tissue culture.

PHYSICISTS AND CHEMISTS

Several posts are now available for scientists interested in

The physical chemistry of combustion

Materials science of combustible materials (including tobacco)

Synthetic chemistry and

Analytical chemistry

Both long term and development problems are dealt with in inter-disciplinary groups. Applicants should be keen to apply scientific skill to commercial problems.

STATISTICIAN/BIOMETRICIAN

An Honours Graduate in mathematics, statistics and/or computing to develop techniques for the collection, analysis and interpretation of research data, particularly those from biological evaluations.

The Company offers first class conditions of service and initial salaries will be negotiable.

Applicants, male or female, may be graduates with suitable experience. For posts other than that of Group Leader—Biology Group, 1974 graduates may apply. Please write giving details of relevant academic and practical experience to—

W. H. Forsythe, Manager, R. & D. Laboratories,
GALLAHER LIMITED, R. & D. Division,
Virginie House, Henry Street, Belfast BT15 1JE

CHEMIST OR METALLURGIST having a good honours degree or equivalent is required by a large industrial R. & D. organisation to investigate novel plating baths including the quality of deposits. Age up to approximately 30 years. Reference - AC20. Reply to The Secretary, RNP Metals Technology Centre, Grove Laboratories, Denworth Road, Wantage, Oxon OX12 9BJ.

TRANSLATORS (RUSS.-ENGL.), Translation Editors, Proofreaders, Freelance, wtd. Control Eng. Metallurgy, Metal Physics, Electrochem. Box 1748.

Biologist/ Histologist

ICI Pharmaceuticals Division

Our Safety of Medicines Department has a vacancy for a Biologist/Histologist to act as Head of the Histology Laboratory.

The Laboratory prepares containers for animal tissues to be examined in our toxicity studies and applies a routine procedure for preparing tissue sections for evaluation by a pathologist. The Head of the Laboratory oversees this procedure and is responsible for the identification of samples, maintenance of records and meeting of target dates. He also assists in the selection, training, and assessment of staff.

The successful candidate preferably should have obtained his F.I.M.L.T. in this speciality, although A.I.M.L.T. would be acceptable if the applicant had considerable

experience of managing a group of people carrying out this type of work. We are looking particularly for a person who has the ability to manage a group of technicians largely concerned with a high throughput, but routine procedure, which when carried out to the desired level of quality, demands skills which can only be acquired by training and experience. In addition, guidance must be given to staff when requests are made for a non-routine nature.

Please write, asking for an Application Form, to:

Miss K. E. Webster, Personnel Officer,
Imperial Chemical Industries Limited,
Pharmaceuticals Division,
Mersey, Alderley Park,
Nr Macclesfield, Cheshire.



MEDICAL INFORMATION

Assistant Information Executive

Roussel Laboratories Limited is part of a large, international group researching, developing, manufacturing and marketing a wide range of pharmaceutical and allied products in the U.K. and overseas.

An opportunity exists for a graduate in pharmacy or biological sciences with previous experience in medical information service within our busy medical department.

The Assistant Information Executive will report directly to the Information Executive and will enjoy backup support, in terms of personnel and a newly-installed retrieval system, in fulfilling the responsibilities of interpretation of the literature, preparation of scientific and medical reports and answering technical queries.

The successful applicant will be paid an attractive salary with excellent fringe benefits including free lunches.

For an application form or further information please contact:

Miss M. L. Eames,
Personnel Officer,
Roussel Laboratories Limited,
Roussel House, Wembley Park,
Middlesex HA9 0NF.
Tel. 01-903 1454

ROUSSEL

STUDENTSHIPS

UNIVERSITY OF EXETER Department of Biological Sciences

Applications are invited for a Natural Environmental Research Council Studentship to investigate the interaction of soil animals and micro-organisms in the decomposition of leaf litter.

The value of the Studentship is £295 per annum plus fees (£540 per annum in the case of students living at home). Other allowances are payable in certain circumstances.

Candidates will be expected to obtain a good Honours degree in Biological Sciences. A working knowledge of biochemistry will be useful.

Application forms and further particulars can be obtained from the Senior Assistant Registrar, quoting JMA/NERC/Biol. Sci., Northcote House, The Queen's Drive, Exeter EX4 4QJ. Closing date for applications May 16th, 1974.

UNIVERSITY COLLEGE LONDON

Department of Chemical Engineering

Applications are invited for the post of Post-doctoral Research Assistant to work on an SRC supported project concerning the pyrolysis of hydrocarbons in a shock-tube. Salary £2058+£162 London allowance and PSSU.

Applications, with the names of two referees should be sent as possible to Dr. J. A. Barnard, (NS) Department of Chemical Engineering, University College, London, Torrington Place, London WC1E 7JE, from whom further particulars are available.

ROYAL COLLEGE OF ART Department of Design Research POSTGRADUATE RESEARCH STUDENTSHIPS IN DESIGN RESEARCH

The appointed students will work closely either with a multi-disciplinary research team studying the theoretical, methodological and practical problems analysing and modelling architectural and other design behaviour or with a team studying and creating modelling techniques as aids to designers.

Applicants should have an honours degree or equivalent background in one or several of the following disciplines: Operational Research, Applied Mathematics/Statistics, Computer Science, Psychology, Cybernetics.

The studentships are for a two year period during which time the student will be expected to read for a Master's degree of the Royal College of Art.

Further particulars and application forms are obtainable from The Research Tutor, Department of Design Research, Royal College of Art, Kensington Gore, SW7 2EU.

HERIOT-WATT UNIVERSITY Applications are invited for a CASE STUDENTSHIP

in the Department of Chemistry. The successful applicant will work in collaboration with Organo Laboratories Ltd. on new amino steroids in a research already established as possessing interesting pharmacological and clinical properties. The project will involve working both in the University and the industrial laboratories.

The University is situated in a parkland campus just outside Edinburgh.

The student, who should have a good Honours degree, will register for the degree of Ph.D. Enquiries should be sent to Dr. M. M. Campbell, Department of Chemistry, Heriot-Watt University, Riccarton, Midlothian, EH14 4AS.

UNIVERSITY OF EDINBURGH RESEARCH STUDENTSHIPS IN SOCIAL ASPECTS OF SCIENCE

Studentships are available in the Science Studies Unit, Edinburgh University for research on Appropriate Technology for Developing Countries; Differentiation in Modern Astronomy; and aspects of the Social History of British Science.

Applicants must have (by July 1974) a good first degree (in preferably) science, technology, social sciences or history. Contact: The Director, Science Studies Unit, University of Edinburgh, 34 Buccleuch Place, Edinburgh, EH8 5JT. Please quote reference 5014.

WESTFIELD COLLEGE (University of London)

NERC RESEARCH STUDENTSHIP

For work on "Water and ion movement in live Sphagnum and peat" is available from October 1974. Peat covers about 2 per cent of the Earth's surface. The ecology of one of the major peat forming plants is to be studied.

The bursary is £205 a year and is under the NERC regulations. Applicants who have or hope to have a good honours degree in Biological, Chemical or Physical Sciences will be considered.

Apply by 28th May to Dr. R. S. Chrys, Westfield College, Kintoppe Avenue, Hampstead, London, NW3 7ST.

MONASH UNIVERSITY Department of Genetics SENIOR TEACHING FELLOW

Applicants should normally have completed a MSc or PhD degree and will be responsible for the preparation and presentation of practical classes in Genetics in various years of the science course. The successful applicant will be expected to start late in 1974 or early in 1975. Facilities will be available for the successful applicant to undertake research in collaboration with the staff members of the Department.

Salary range: £4720-£6895 per annum with superannuation based on an endowment assurance scheme. The employer and employer contributing 5% and 10% respectively.

Benefits: Travelling expenses for appointees and family removal allowance, temporary housing for an initial period, repatriation after three years service if desired.

Further general information and details of application procedure are available from the Academic Registrar, Monash University, Wellington Road, Clayton, Victoria 3168, Australia. Enquiries may be addressed to Professor R. W. Holloway, Chairman of the Department from whom a detailed statement of current departmental research interests is available. Applicants should quote reference No. 50713.

Closing Date: 31 May 1974.

The University reserves the right to make no appointment or to appoint by invitation.

UNIVERSITY OF LIVERPOOL Department of Botany SRC/SSRC RESEARCH STUDENTSHIP

Applications are invited from graduates with a first or upper second class Honours degree, or those graduating this year, for one SRC/SSRC Research Studentship, tenable from 1st October 1974.

The research topic is a study of the variation, performance and taxonomy of *Sorbus aucuparia* (Rowan) and related species as amenity trees. This will be combined with course work and tutorials in land planning and landscape design in the Department of City Design. It is intended to give a broad interdisciplinary training suitable for a person interested in the applications of botanical research to practical problems.

Applications, indicating academic background, and accompanied with the names of two referees, should be received not later than 10th May 1974 by the Academic Registrar, The University, P.O. Box 147, Liverpool, L69 3BX. Quote ref. RV/NS/80752.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY London SW7 Biochemistry Department

Postgraduate Research in Biochemistry and Biology of Micro-Organisms

Grants will be available for suitable candidates interested in research on the following topics:

Physiological and biochemical studies on argot fungi growing in artificial culture and on host plants, with special particular to metabolic products e.g. alkaloids. (Dr A G Dickerson and Dr F G Mantle).
The physiology, biochemistry and genetics of Myxomycetes (Plasmodial Slime Moulds), especially studies on cell fusion and somatic incompatibility. (Dr M J Carliell).

Physiology of fungi, especially chemotaxis and chemotropism. (Dr M J Carliell).

LANDSCAPE ARCHITECTURE Research studentships available for honours graduates in land use or natural science subjects. Apply Department of Landscape Architecture, The University, Sheffield S10 2TN.

FELLOWSHIPS, GRANTS AND SCHOLARSHIPS



LOUGHBOROUGH
UNIVERSITY OF
TECHNOLOGY

Hydrogen Engine

Applications are invited from engineering or physics graduates or potential graduates for an SRC studentship working on the development of a hydrogen engine. The studentship is tenable for one year in the first instance, renewable up to three, and the successful applicant will be expected to work for a higher degree.

This is one of a number of studentships available in the University's Department of Transport Technology. Other research areas include noise, vehicle dynamics, engines and transmissions, and transport planning. For further details of these studentships and of the work please write to Professor David Johns, Department of Transport Technology.

Loughborough

Lancasterhire

APPLICATIONS OF LASERS IN SPECTROSCOPY

Applications are invited for a postdoctoral fellowship in the applications of lasers to the study of high temperature inorganic species in gases. Applicants are asked to send a curriculum vitae to Professor I. R. Beattie (Department of Chemistry, The University, Southampton SO9 5NH) from whom further details may be obtained. Salary on the range £1929-£2223 (under review) plus PSSU.

Glaxo Travelling Fellowships for British Science Writers

FOUR AWARDS —
EACH WORTH £500

Applications and nominations are invited for the 1974 Glaxo awards, which are open to all British science writers — specialists and general reporters, regional and national staffmen, and freelancers in newspapers, periodicals, radio and television. Applications may be made by either individual science writers or by editors on their behalf.

One £500 award is for science writing in a national magazine or newspaper during 1973.

One £500 award is for science writing in a regional magazine or newspaper during 1973.

One £500 award is for science writing in television or radio during 1973.

One £500 award is for science writing in a trade, technical or house magazine during 1973.

Closing date for entry: 31 May 1974.

Further details and application/nomination forms can be obtained from:

The Chairman, Association of British Science Writers, c/o New Scientist, 128 Long Acra, London WC2E 9QH.

DYFED COUNTY COUNCIL THE THOMAS AND ELIZABETH WILLIAMS SCHOLARSHIPS

(Llanelli School District)
Applications are invited for Postgraduate Scholarships from university honours graduates and also persons possessing professional or technical qualifications equivalent to a university honours degree. Applications are not restricted to a particular field of study but special consideration will be given to applicants desiring to enter upon postgraduate work in the United States of America. The Scholarships to be awarded will be of a substantial character and normally are intended to meet the cost of tuition, maintenance and travel of the successful applicants.

Applicants must have been resident for at least two years during the ten years immediately preceding the date of application within the areas formerly known as—

- The area comprising the Llanelli School District, viz. the Borough of Llanelli and the Parishes of Llanelli Rural and Pontyberem;
- The Administrative County of Carmarthen with the exception of the Kidwelly School District viz. the Borough of Kidwelly together with that part of the Parish of St. Ishmael served by the Llanelli County Primary School; the Urban District of Burry Port and the Parishes of Pembrey, Llanedfelloeg, Llangendrineis, and the remainder of the Parish of St. Ishmael.

In the award of Scholarships, preference will be given to candidates who satisfy the requirements within category (a) above, and if there are no worthy applicants or not a sufficient number of worthy applicants to satisfy such requirements, Scholarships may be granted to persons who satisfy the requirements of category (b). Candidates must not be above the age of thirty years at the date of application for a Scholarship.

Further particulars and forms of application are obtainable from the undersigned on receipt of a stamped addressed envelope, and completed applications must be returned not later than 31st May 1974.

HENRY D. THOMAS, Chief Education Officer, County Hall, Carmarthen.

DYFED COUNTY COUNCIL THE THOMAS AND ELIZABETH WILLIAMS SCHOLARSHIPS

(Kidwelly School District)
Applications are invited for Postgraduate Scholarships from university honours graduates and also persons possessing professional or technical qualifications equivalent to a university honours degree. Applications are not restricted to a particular field of study, but special consideration will be given to applicants desiring to enter upon postgraduate work in the United States of America. The Scholarships to be awarded will be of a substantial character and normally are intended to meet the cost of tuition, maintenance and travel of the successful applicants.

Applicants must have been resident for at least two years during the ten years immediately preceding the date of application within the areas formerly known as—

- The Borough of Kidwelly together with the part of the Parish of St. Ishmael served by the Llanelli County Primary School;
- The Urban District of Burry Port and the Parishes of Pembrey, Llanedfelloeg, Llangendrineis, and the remainder of the Parish of St. Ishmael;
- The Administrative County of Carmarthen with the exception of the Llanelli School District, viz. the Borough of Llanelli and the Parishes of Llanelli Rural and Pontyberem.

In the award of Scholarships, preference will be given to candidates who satisfy the requirements within category (a) above, and if there are no worthy applicants or not a sufficient number of worthy applicants to satisfy such requirements, Scholarships may be granted to persons who satisfy the requirements of category (b) and thereafter category (c). Candidates must not be above the age of thirty years at the date of application for a Scholarship.

Further particulars and forms of application are obtainable from the undersigned on receipt of a stamped addressed envelope, and completed applications must be returned not later than 31st May 1974.

HENRY D. THOMAS, Chief Education Officer, County Hall, Carmarthen.

LECTURES, MEETINGS
COURSES

UNIVERSITY OF BRISTOL

H. H. Wills Physics Laboratory

Applications are invited from candidates with, or expecting to graduate with, a good honours degree in Physics, Chemistry, Mechanical Engineering, Metallurgy, Ceramics or related subjects, for admission to a one year course for advanced study and research leading to the degree of

M.Sc. IN THE PHYSICS
OF MATERIALS

The Course concerns the basic physical mechanical mechanisms underlying the mechanical properties of solids of all kinds and is particularly appropriate for new graduates who intend to enter laboratories involved in materials research.

Candidates who successfully complete the Course may be considered, if they wish, as qualified to proceed to further research work in the laboratory as candidates for the degree of Ph.D.

Enquiries should be addressed to Professor F. C. Frank F.R.S., Director of the H. H. Wills Physics Laboratory, Tyndall Avenue, Bristol BS8 1TL.

IMPERIAL COLLEGE OF
SCIENCE AND
TECHNOLOGY
M.Sc. COURSE
PLANTS AND
ENVIRONMENT

Applications are invited for the three 12-month course, starting in October. The course is a study in depth of the plant environment, growth and yield, and the responses of plants; and is practically oriented. Each student undertakes research in the second part of the course. Applicants should be graduates in Biology, Botany, Agriculture or Forestry, with a limited number of NERC studentships available. Further details can be obtained from Professor A. J. Butter, Botany Department, Imperial College, London, SW7.

MIBiol (by Examination) in
ENTOMOLOGY or
PLANT PATHOLOGY

This is a two year course, including 6 months industrial experience during the first year, leading to Membership Examinations of the Institute of Biology.

Entrance requirements: an appropriate pass at HND, NDA, or BSC. Graduates may be exempt from the first year of the course.

Full details from: The Secretary, Department of Biological Sciences, The Polytechnic, Wolverhampton WV1 1LY.

UNIVERSITY OF STIRLING
TECHNOLOGICAL
ECONOMICS
SHORT COURSES

- Three courses of interest to managers and technologists:
1. Technological Economics in Pesticide Manufacture, 3-7 June.
 2. Investment Appraisal, 11-12 June.
 3. Investment Decision-taking for R & D, 17-21 June.

Further details from Dr B. E. Thomas, Department of Industrial Science, University of Stirling, Stirling, Tel: Stirling 3171, ext. 2287.

The Polytechnic
of North London

Science and Technology

MS.c. Courses

(The full time courses are recognised by the Science Research Council for the award of Advanced Course Studentships)

Applications of Computing (F)

For honours graduates in mathematics, science, engineering, business studies or economics.

Physical Basis of Electronics (F, P, E)

Modular course for graduates in physics, electrical engineering or allied disciplines.

Applied Statistics (P)

For graduates with an honours degree including mathematics or a recognised equivalent.

Electrons, Ions & Photons in Gases (E)

For graduates in physics or allied subjects; those suitably qualified take the University of London M.Sc. in Electrical Discharges in Gases.

Inorganic Macromolecules (E)

For chemistry graduates, particularly those in the polymer, ceramic, glass or related industries.

Other Advanced Courses

Polymer Science & Technology (F)

Courses specialising in either rubbers or plastics science and technology leading to recognised professional qualifications for holders of suitable U.K. degree, HND, HNC or equivalent qualifications. A number of valuable industrial awards are available.

Pollution Control (P)

Multi-disciplinary course leading to College Postgraduate Diploma.

Research (F, P)

There are well established research groups in all departments with students working for CMAA M.Phil and Ph.D. degrees, or, in some departments, for University of London degrees. There may be some research grants available or vacancies for research students.

F Full-time, P Part-time, E Evenings only.

Details from Admissions Officer (NS/PCN), The Polytechnic of North London, Holloway N7 8DB.

North East London
Polytechnic

The Starling Lectures

Nuclear Power for
Propulsion Purposes

Professor J. Edward WhitSch FCGI BSc FIMechE CEng

Head of Department of Nuclear Science and Technology

Royal Naval College, Greenwich

Tuesday 21 May 18.30 - West Ham Room 34

The Starling Lectures are intended to provide up-to-date reviews of various topics of nuclear and radiation science. They are presented mainly for the benefit of those who have not specialised in the subject areas concerned but they are provided by lecturers who are recognised authorities on these subjects. This, the sixth lecture in the series, will deal with the present situation and the future prospects of nuclear power as a propulsive system.

Application for free tickets to:

Dr. W. H. Tails, Ref. B1641

North East London Polytechnic
Romford Road, London E15 4LZ. 01-555 0811 Ext. 45.

UNIVERSITY OF READING

FULL OR PART TIME
MSc COURSE IN
APPLIED & MODERN OPTICS

This is a 1-year course for the MSc degree by examination. To provide in-service specialist training for those in industry, the course may also be taken on a part-time basis over two years.

The course is open to graduates in physics, mathematics or engineering. Students with recognised equivalent qualifications may also be admitted.

SRG Advanced Course Studentships are available for suitable applicants, and other forms of financial support may be possible.

Opportunities also exist for research leading to the Ph.D. degree.

Further details may be obtained from Prof. H. H. Hopkins, FRS Department of Physics, The University, Whiteknights, Reading, RG6 2AF.

UNIVERSITY OF
EAST ANGLIASchool of Biological Sciences
Course for Biology Teachers
22-26 July, 1974

This is a residential/non-residential course of lectures, practical sessions and seminars. Participants can choose to study in one of two sub-courses:

A Cell Biology: Origin and function of cell organelles

B Radionuclides in the School

The course will be of particular interest to teachers of "A" level Biology and seminars. Further details are obtainable from: Dr G. Rich, School of Biological Sciences, University of East Anglia, Norwich, NOR 86C.

AWARDS

DO YOU NEED A Scientific Secretary? Young female honours graduate (Nutrition) with full secretarial qualifications and experience at director level seeks stimulating post in London area. Please reply to Box 1749.

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FOR SALE

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Further details apply Dr J. Billingham, Department of Materials, Cranfield Institute of Technology, Bedford (Bedford

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CONTACTS
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Ariadne

One of the disadvantages of the world becoming smaller—there are many others—is that it is becoming increasingly difficult to ignore the other fellow's plight. Considering the amount of evidence of misery readily to hand, the better-off countries, however, manage surprisingly well to avoid the seemingly inescapable conclusion that their way of life must be an affront to something like two-thirds of the world's inhabitants? Or would it be the vast network of communication were genuinely two-way. Take for instance a recent remark by Professor Jean Mayer, the Harvard nutritionist quoted by Anthony Lewis in the New York Times: "The same amount of food," said Mayer, "that is feeding 210 million Americans would feed 1 500 million Chinese on an average Chinese diet." The Americans of course are meat eaters, which means it takes 2200 lb of grain per head per year to feed them (140 lb in bread and other cereal food, the rest to the cattle). The Chinese use 400 lb per head, 360 lb as grain. It could be argued, as Lewis suggests, that Americans have a moral duty to change their eating habits so that more grain might be made available to save people from dying of hunger. But why only the Americans? Would the rich European nations cut down their eating levels, if, say, the United Nations launched an appeal? Does the shopper staggering heavy laden from the supermarket ever recall the Ethiopian famine pictures he may have seen on television the previous evening? My guess is that though consciences are sluggish, they could be aroused if governments set the moral tone. Desultory references to "foreign aid" are not the way. Meanwhile, there will be a huge food deficit in Asia this year. Why should the American conscience bear so much of the burden?

A recent TV film displayed the arrogance of British officialdom towards the growing demand for more information to be made available to the public on such matters as environmental damage through industrial wastes. Even elected local authorities, it seems, find acts of Parliament being cited to show that they are not entitled to information which might help them to put an end to some nuisance or other that plagues their citizens. Of course its early days; people are only beginning to discover that one man's chest troubles are a by-product of another man's productivity. When the message does get home—and the BBC film must have enlightened several millions of us—the faceless bureaucrats complacently administering the existing laws on "confidentiality"—are in for a rough time. The Americans are lucky enough to have a body called the Environment Defense Fund, which has sued the Federal Aviation Administration to compel it to come clean about noise guidelines for Concorde and its Soviet counterpart. As things stand they would not meet the noise limits for subsonic

aircraft but, being a different sort of beast, they might force their way through a loophole. The FAA has stalled for a year and the EDF people believe the game is to wait until the SSTs are about to fly commercially and then cave in, saying it's too late in the day to ask for radical modifications.

At the new Dallas-Fort Worth airport they have perhaps the world's biggest network of people movers. People movers? Yes, little cars on rails that carry you more or less wherever you want to go simply by pressing a button. The whole network is of course computer controlled so that the best use can be made of the cars available. Computerworld (17 April) tells a charming story of a car that got out of line. Signalled as about to arrive with a load of passengers, it failed to turn up and a search was made. It was finally found going through the washing bay again and again—five trips, in fact. Its last load of humans must blush to learn of the amount of ritual cleansing they seem to have occasioned.

An entry from a London reader for that dictionary of science/technology double-talk I mentioned. "It is thought," he writes, "to have originated in the Pentagon, with particular reference to difficulties encountered with component sub-contractors working on the development of the Terrier naval anti-aircraft missile system." Anyhow, if you mean that the whole thing doesn't hang together you talk of a "sub-systems interface mismatch." It has the authentic crew cut teutonic ring that you associate with Ron Zeigler in his prime.

My autolucifer friend Daedalus deplors the electricity wasted on electric lamps, which emit so little of their energy as light. He recalls the image-intensifiers of night warfare, and plans to extend the

principle to humane uses. Some sort of laser-amplifier, emitting hundreds of photons for every one which hits it, would be ideal. Daedalus recalls those crafty auto-darkening spectacles whose glass contains silver chloride. In bright light, silver is deposited as a fine-grain black dispersion in the glass. In the shade the silver reverts to the transparent chloride. Suppose, argues Daedalus, that this glass was strongly heated. If quite transparent it could glow only feebly if at all: for emission is proportional to absorption. But when a photon hit it, depositing a grain of silver, the opaque grain would glow strongly, emitting many photons where the original one entered. In fact this device is a type of thermally-pumped laser giving strong amplification of light traversing it. So DREADCO opticians are devising quartz/silver chloride optical sheets, electrically heated by conducting transparent anti-reflection surface coatings, and vacuum-sandwiched between glass screens to minimise heat loss. Already prototype spectacles, windscreens, telescopes, etc are being built, and Daedalus foresees a ready market. The CEBG's lighting load will plummet as thermal-spectacle wearers find out how well they see by the light of a candle or 5-watt lamp; the nocturnal sodium haze will dwindle to a glimmer as motorists amplify the street-lights and their own headlights through thermal windscreens; and the back seats of the cinema will no longer be havens of amorous obscurity. The brightness of the glasses can be controlled via the heating current, and the deluxe version will do this automatically from a photocell registering the ambient light. The lucky wearer will become oblivious of night or day: driving into the sunset, changing a fuse under the stairs, watching nocturnal wildlife or reading on the beach, all will be the same to him. A pity this clear, even world will necessarily be monochrome.



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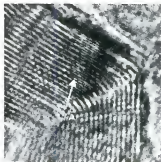
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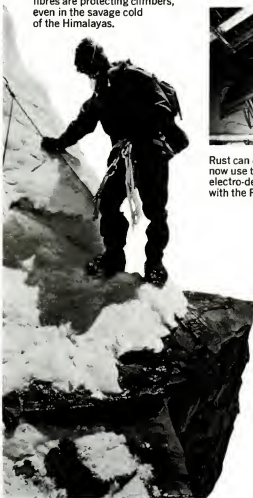
PHILIPS

Quiet revolutions

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Rust can destroy a car's bodywork. Many manufacturers now use the 'Electrocoat' process of priming by electro-deposition. It's been developed by ICI in conjunction with the Pressed Steel Fisher Division of British Leyland.

Keeping packaged goods crisp and fresh used to cause problems for many food manufacturers. Now they use an ICI thermoplastic - strong, transparent 'Propafilm' - to provide an economical, effective moisture barrier.



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